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An Application of Interindustry Analysis To San Benito County, California

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FOREWORD AND ACKNOWLEDGMENTS

More and more counties and cities in California, in an effort to solve some of their many problems of economic growth, are now formulating plans of action for the provision of public facilities for residential and industrial uses and for the conservation of their land and other natural resources. To assist them in effective planning, local decision makers, both public and private, are eager to obtain pertinent and useful information relating to the structure and growth of the economy of their communities. Interindustry analysis, more familiarly known as input-output analysis, is one of the techniques developed by economists to describe and evaluate some aspects of the economic growth. A valuable tool of economic analysis, this methodological technique can be varied in its application to allow for conditions peculiar to any region under examination.

Such an analysis has been made of the economy of San Benito County, California, the results of which are summarized in this report. The theoretical implications of interindustry analysis are developed briefly, and the empirical results obtained from such an analysis are discussed in some detail. It is hoped that this report may be helpful to local policy analysts and other concerned individuals who are struggling to solve some of the complex economic problems facing their communities.

The authors wish to express their gratitude to the many people of San Benito County who showed their genuine interest in the study. Their hospitality and cooperation with interviewers in the economic survey conducted by the authors far exceeded the usual response obtained by researchers. Particular thanks are due Mr. E. C. "Rocky" Lydon, San Benito County Director of the California Agricultural Extension Service, who provided immeasurable assistance, and to the County Board of Supervisors, under the farsighted leadership of Mr. Ed Waldemar, who gave the study official sanction.

The rigor and refinement of the analysis were greatly improved by Dr. Irving Hoch, Department of Agricultural Economics, Berkeley, whose criticisms and suggestions were especially constructive and went beyond the usual contributions of a friendly reviewer. The clarity and elegance of the text were greatly improved by Mrs. Miriam Revzan whose editorial skills were invaluable. Drs. O. P. Blaich, Eric Thor, and H. O. Carter, among others, also made helpful contributions. The efforts of the typists and statistical aids, whose dedication to neatness and detail always earns our awe, are also gratefully acknowledged. In conclusion, it should be noted that any flaws and errors remaining in this report are attributable solely to the authors.

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AN APPLICATION OF INTERINDUSTRY ANALYSIS TO SAN BENITO COUNTY, CALIFORNIA

by

S. Ananda Rao[1/] and David J. Allee[2/]

INTRODUCTION

Interindustry analysis, as a technique of comprehensive analysis of a regional economy, is based upon the input-output flow of goods and services produced in a given region. Basic information on interindustry purchases and sales within and outside the selected area is used to reflect the nature and extent of interdependence among the various economic sectors in the region.

At least two studies have recently been made in which this analytical technique has been applied to specific regions in California.[3/] However, in neither of these studies, nor in any other known California study to date, has regional input-output analysis been applied to so small an area as a single county. In the present study, this technique has been used to analyze the economic structure of San Benito County, California.

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3/ California Economic Development Agency, Markets for California Products: An Analysis of the Sources of Demand, by W. L. Hansen, R. T. Robson and C. H. Tiebout (Sacramento, 1961), 90p.

William E. Martin and Harold O. Carter, A California Interindustry Analysis Emphasizing Agriculture. Part I: The Input-Output Models and Results and Part II: Statistical Supplement, University of California, Giannini Foundation Research Report No. 250 (Berkeley, 1962), 79p. and 121p., respectively.

Both of these studies analyze the structure and growth of the California economy, the first in terms of four regions: (1) the entire state of California; (2) the Los Angeles-Long Beach region; (3) the San Francisco-Oakland region; and (4) the remainder of the state, consisting of California minus the two metropolitan regions. The second study was done in terms of interaction among economic sectors of the state as a whole, between its northern and southern segments, and between California and the rest of the world.

San Benito County was selected for study as one of California's many non-metropolitan counties which have begun to show definite signs of urbanization. Its problems of growth and urbanization, however, have not yet become as acute as those of adjacent counties. An extensive analysis was recently made of its economic growth, with special attention given to land values and uses.[1/] The interindustry analysis reported here grew out of this broader investigation and was undertaken primarily for the purpose of examining and identifying the interactions among the County's several economic sectors. Specifically, its objectives are to determine:

1. To what degree the economy of San Benito County is self-sufficient.

2. To what extent the County is dependent on outside markets for its products and services.

3. The effects of changes in one industry's output and employment upon the rest of the County's economy within the input-output framework.

While a considerable body of data relating to the local economy of San Benito County, particularly its agriculture, is available in regularly published sources, this information was nevertheless considered inadequate for purposes of interindustry analysis. A mail survey, with supplementary personal interviews, was therefore conducted to collect the additional required information concerning interrelationships among the local industries.[2/] The survey included all the commercial and industrial firms in the County, totaling slightly over 200, but excluded all farm firms since the needed agricultural information could be obtained elsewhere. The few remaining gaps in the

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1/ S. Ananda Rao, "Analysis of Land Values and Uses in the Context of Local Economic Growth: An Empirical Approach With Special Reference to San Benito County, California" (unpublished Ph.D. dissertation, Department of Agricultural Economics, University of California, Berkeley, 1963); see particularly Chapters II and V.

2/ The survey was conducted during the spring and summer of 1962; the data collected were for 1961. The survey questionnaire, together with instructions and explanatory notes, may be obtained by request from the Giannini Foundation of Agricultural Economics, University of California, Berkeley

collected data were then filled by means of some adjustments and approximations, and thus complete data were developed for each economic sector entering into the interindustry flow of goods and services.1/

INTERINDUSTRY FLOWS IN SAN BENITO COUNTY

To satisfy the initial requirement of interindustry analysis, a flow table was constructed for San Benito County to show how the output of each economic sector was allocated to each sector making use of that output. For purposes of this study, two alternative models were then developed, representing two different analytical approaches. These models differ only in the treatment of the household sector of the economy--as part of final demand and therefore exogenous (Model I) or as a component of the endogenous structure (Model II).2/ The mathematical formulations of both models are discussed in a later section. The economic sectors selected for the analysis are classified in the next section which also includes the definition of selected economic terms.

Definitions and Classifications

The following definitions were adopted in the preparation of the data used in the flow table and the succeeding analysis:

Output--gross value (to the purchasers) of output sold or services rendered, in 1961 dollars.3/

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1/ The steps involved in the tabulation of survey data and the assumptions made in order to develop complete data for each economic sector represented are presented in Appendix A. Data sources and the adjustments required for construction of the input-output models are given in Appendix B.

2/ For an illustration of a model similar to Model II, see Irving J. Hoch, "A Comparison of Alternative Inter-Industry Forecasts for the Chicago Region," Papers and Proceedings of the Regional Science Association: Fifth Annual Meeting Held in Chicago, December, 1958, Vol. V., ed. by Gerald A. P. Carrothers, (Chicago, 1959), pp. 217-235.

3/ Alternatively, the producers' value of output could be used. In this study, purchasers' value was used because producers' value of output is more difficult to obtain, sometimes even impossible. For a similar use of purchasers' value in input-output analysis, see Hollis B. Chenery, Paul G. Clark, and Vera Cao Pinna, The Structure and Growth of the Italian Economy (Rome, Italy: Mutual Security Agency, 1953).

Employment--expressed in man-year equivalents (rather than number of employees at a given date).

Income--total personal income of households, as defined by the U. S. Department of Commerce in its Survey of Current Business.

Brief descriptions of the economic sectors included in the models follow. The first five sectors are endogenous in both Models I and II.

1. Agriculture--all farms in San Benito County that produce agricultural commodities.

2. Food Processing (often termed "agricultural industry")--all firms that process and/or can food products.

3. Manufacturing--all firms that manufacture nonfood products.

4. Nonmanufacturing, including business services--an aggregation of:

   (a) nonmanufacturing industry, consisting of minor processing and extracting plants which do quarrying and mining and firms that perform repair services;

   (b) construction firms which perform building and contracting services;

   (c) finance, real estate, and insurance firms; and

   (d) selected services, such as laundries, auto repair services, garages, hotel and motels, and others included in the U. S. Census of Business, 1958.

5. Wholesale and retail--all firms in San Benito County that conduct wholesale and/or retail business. These two economic sectors were aggregated because many firms perform both activities and separate sales figures for each were unobtainable.1/

6. Household--treated alternatively as an exogenous sector in Model I and as an endogenous sector in Model II:

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1/ This sector is treated variously in input-output analyses. For example, in Martin and Carter, A California Interindustry Analysis. . . . Part II. . . ., pp. 66-68, the wholesale and retail sector is aggregated with transportation, and the aggregated trade and transportation sector is handled in such a way that only the value of services performed by this sector enters the input-output flow table. This was done after estimating the margins (the value of services performed by the trade sector) on the basis of the U. S. Bureau of Labor Statistics studies on the United States economy for 1947. A similar estimation of margins for this study was rejected as too cumbersome. Furthermore, it was felt that gross flow values probably would have more meaning for the local people who might make use of these data.

(a) Model I--exogenous--represents the local consumption component of final demand.

(b) Model II--endogenous--both a producing and consuming sector; that is, supplies labor services to other producing sectors and consumes the products of other sectors.

7. Exports--an exogenous sector, consisting of all sales made outside the County.[1/] Sales to government, at all levels, were treated as exports and included in this sector.

Unallocated inputs represent residuals which serve to balance the totals of corresponding rows and columns in the flow table. In this study, they constitute an aggregated sector composed of (1) local inputs not otherwise explicitly recognized, such as rent, taxes, transportation, and utilities; and (2) inputs imported from outside the County for local interindustry demand and for final consumption.[2/] By this means, the total output of each sector, or industry, is completely allocated to interindustry consumption, final consumption, or exports.

The Interindustry Flow Table

Table 1 summarizes the interindustry flow of goods and services for San Benito County, developed from data for the year 1961. In the familiar input-output format, it shows the disposition made of each sector's output among the purchasing and final demand sectors.

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1/ The data used were obtained in the survey described earlier and represent net exports--net in the sense that there could be some crosshauling, for which information was not readily available.

2/ An alternative method of handling imports would involve the collection of elaborate import data for each industry and then expressing these data as an import matrix instead of a single import row. The import matrix could establish relationships between input-output and interregional competition. A fusion of these techniques could be developed, considering in some detail the differences in price levels, transportation costs, etc. This device could be useful in deciding whether a product or service should be produced locally or imported. This is an area of research still to be explored. The input-output table with an expanded import matrix is defined in the literature as the dog-leg matrix.

TABLE 1

Interindustry Flow of Goods and Services by Economic Sectors

Producing sectors	Purchasing sectors[a]							
	Agriculture	Food processing	Manufacturing	Nonmanufacturing, including business services	Wholesale and retail	Household (consumers)	Exports	Total output[b]
	1	2	3	4	5	6	7	8
	thousand dollars							
1. Agriculture	2,831 (13.36)[d]	3,777 (17.82)	[c]	[c]	212 (1.00)	[c]	14,373 (67.82)	21,193 (100.00)
2. Food processing	1,252 (9.41)	5 (0.04)	1 (0.01)	[c]	18 (0.14)	[c]	12,036 (90.41)	13,312 (100.00)
3. Manufacturing	220 (3.31)	8 (0.12)	37 (0.56)	105 (1.58)	3 (0.05)	230 (3.46)	6,038 (90.92)	6,641 (100.00)
4. Nonmanufacturing, including business services	831 (4.17)	1,713 (8.60)	1,975 (9.92)	5,297 (26.61)	553 (2.78)	5,367 (26.96)	4,173 (20.96)	19,909 (100.00)
5. Wholesale and retail	3,116 (13.51)	87 (0.38)	17 (0.07)	223 (0.97)	204 (0.88)	17,834 (77.30)	1,589 (6.89)	23,070 (100.00)
6. Household (labor)	8,769	2,700	2,658	9,507	2,213	5,430	8,477	39,854
Unallocated inputs[e]	4,174	5,022	1,953	4,777	19,867	10,993	[f]	46,786
Total inputs[b]	21,193	13,312	6,641	19,909	23,070	39,854	46,786	170,765

(Continued on next page.)

TABLE 1--continued.

a/ Sectors 1-5 were treated as endogenous in both Models I and II, and the exports sector was handled as exogenous in both models. The household sector, however, was treated as exogenous in Model I and endogenous in Model II. Thus, in Model I, column 7 constitutes the total final demand; in Model II, final demand consists of column 6 plus column 7.

b/ Total output of each row sector and total inputs of each corresponding column sector are equal to each other (see text).

c/ Negligible.

d/ Figures in parentheses represent percentages of total output of row sectors sold to column sectors.

e/ This is the undistributed row which represents the residual inputs of each column sector after all local inputs, including labor, are taken into account; that is, it includes all inputs that are not explicitly recognized elsewhere. A large part of these inputs, however, consists of purchases from outside the County (or imports) in the local production of goods and services.

f/ Irrelevant combination.

Sources:

Producing sectors 1-5 were developed from data obtained through the mail survey described in the text.

Household inputs (labor) were estimated from available published data, supplemented with additional information obtained directly from producers in personal interviews.

Unallocated inputs represent residuals.

Row Entries: Producing Sectors

The entries in each row of the flow table represent in purchaser's value the dollar amount of goods or services sold by a producing sector to each of the purchasing or using (column) sectors of the economy. Reading across the first row, for example, the agriculture sector sold $2.8 million, or about 13.4 percent of its output, within itself (column 1); $3.8 million, or about 17.8 percent of its output, to the food processing sector (column 2); and $0.2 million, or 1 percent of its output, to the wholesale and retail sector (column 5). The remaining 67.8 percent of its output, or about $14.4 million, went to final demand, largely as exports outside of the County (column 7); direct sales to local consumers (column 6) were negligible. Entries in the flow table for rows 2 to 5 may be interpreted similarly.

As expected, Table 1 clearly indicates that most of the products of the agriculture, food processing, and manufacturing sectors were exported. On the other hand, the goods and services produced by the nonmanufacturing, including business services, sector and by the wholesale and retail sector were sold within the County.

Household (labor) is entered in row 6 as a producing sector and consists mainly of wages and salaries, proprietors' income (including profits), and other labor and nonlabor income such as interest and dividends. The output of this sector that is sold to the first five purchasing sectors (columns 1-5) represents labor services utilized in those sectors within the County. The output sold to the household sector itself (column 6) represents domestic and some professional services, which in 1961 totaled approximately $5.4 million. Exports (column 7), which constitute the labor inputs of people working outside the County and for the various branches of government, total about $8.6 million.

The household sector's contribution to the economy represents a gross imputed value. Direct estimates of household contribution were not possible for the following reasons:

1. Figures on total employment and wages were not available on a comparable basis.

2. Employment figures were not always given in terms of man-month or man-year equivalents but often reflected only the number of persons employed as of a certain reference date.

3. Unpaid family labor was usually omitted from total hired wages, particularly in the agriculture sector.

Column Entries: Purchasing Sectors

The entries in each column of Table 1 represent the input structure of each purchasing or consuming sector. For example, the food processing sector (column 2) bought approximately $3.8 million worth of goods from the agriculture sector (row 1) and about $1.7 million worth of goods and services from the nonmanufacturing, including business services, sector (row 4). The input from the household sector (row 6)is evaluated at $2.7 million, but the purchased inputs from other sectors are negligible. The aggregate value of unallocated inputs is slightly over $5 million, in part represented by imports of inputs from agriculture and manufacturing (tin cans, for example), which were not supplied by the local sectors. Entries in all other columns can be similarly interpreted.

It is apparent that, in this analysis, the unallocated inputs are an important component of the input structure of each sector. A large part of these inputs consists of durable goods imported for use in local production activity. For example, most of the unallocated inputs ($19.9 million) entered in column 5 (wholesale and retail) represent imports of a variety of durable and nondurable products purchased for resale within and outside the County. In some input-output studies, the output of the wholesale and retail sector is treated in terms of margins instead of sales; when this is done, import coefficients are very low.

The household sector (column 6) represents final consumption by local households, or total personal consumption expenditure. Direct purchases from agriculture and food processing (Sectors 1 and 2) were negligible; and from manufacturing (Sector 3), relatively slight. Purchases from nonmanufacturing, including business services (Sector 4) accounted for nearly $5.4 million. A large proportion--nearly 45 percent--of consumption expenditure by the household sector consisted of $17.8 million in purchases from Sector 5 (wholesale and retail). Consumption by the household sector from other households ($5.4 million) represents primarily personal consumption expenditure on domestic service, as well as medical expenses, legal fees, and other services not already included in the selected services of Sector 4. Unallocated inputs from the household sector amounted to almost $11 million, consisting of personal federal income taxes, nearly $5.0 million; personal savings, about $2.5 million; and approximately $3.5 million in goods purchased directly from sectors outside the County or money otherwise spent outside the County, as on travel.

The total of the household sector (column 6) represents total personal income in San Benito County.

Column 7 (exports) shows the distribution of goods and services produced in San Benito County and exported outside the County. Agriculture, the largest single exporter, exported nearly $14.4 million worth of goods, or about 30 percent of the total exports. Exports of the food processing industry amounted to $12 million; of the manufacturing industry, $6 million; of the nonmanufacturing sector, including mining, construction, and business services, $4.2 million; and of the wholesale and retail sector, about $1.6 million.

INPUT-OUTPUT MODELS, SAN BENITO COUNTY

An input-output model can be expressed as a set of linear equations describing the inflow and outflow of goods and services among the various sectors of an economy. As previously stated, two alternative models, distinguished by their treatment of the household sector, were developed for analysis of San Benito County. In Model I, household is an exogenous sector; in Model II, household is endogenous.

Mathematical Derivation of the Input-Output Models

The mathematical derivation in this section relates explicitly to Model I. The derivation of Model II is analogous.

The mathematical derivation of the open system Model I adopted for our study consists in developing expressions for the linear equations of the system or the interindustry flow table, the matrix of technical coefficients, and the matrix of interdependence coefficients.

Linear Equations of the System--The Interindustry Flow Table

Let X_i be the gross or total output in thousand dollars of industry i ($i = 1, \ldots, 5$) where the subscript i refers to the following endogenous sectors:

Sector 1--Agriculture.
Sector 2--Food processing industry.
Sector 3--Manufacturing industry.
Sector 4--Nonmanufacturing, including business services.
Sector 5--Wholesale and retail trade.

These sectors were defined while explaining the flow table (see discussion on Table 1).

Let X_{ij} represent the amount of output i sold to industry j which is used as input in producing X_j.

Let Y_i be the final demand for output of industry i; that is, the sum of output of industry i sold to consumers (household) and exported outside the County. Thus,

Let Y_{ih} = output of industry i sold to consumers (household);

Y_{ie} = output of industry i exported so that

$Y_{ih} + Y_{ic} = Y_i$.

Let R_j represent the total residual inputs of the dummy sector used in producing the output, X_j, of the industry j. R_j in fact consists of the two components: household, H_j, and unallocated inputs, U_j.

$R_j = H_j + U_j$, where j = 1, . . . , 5, by definition.

Similarly, define the following:

Y_h: flow of goods and services from household to total final demand,

Y_{hh}: flow of goods and services from household to final consumers (household), and

Y_{he}: flow of goods and services from household exported outside the County,

so that

$Y_{hh} + Y_{he} = Y_h$.

Also, let Y_{uh} = unallocated inputs into household sector.

Considering a particular industry i as a producing industry, the total output X_i of that industry can be distributed among the industries and final demand components as follows:

$$X_i = X_{i1} + X_{i2} + X_{i3} + X_{i4} + X_{i5} + Y_{ih} + Y_{ie} \quad (i = 1, \ldots, 5).$$

Similarly, considering household as a producing sector in the exogenous system, the following identity can be formulated:

$$H = H_1 + H_2 + H_3 + H_4 + H_5 + Y_{hh} + Y_{he}.$$

Considering a particular industry j as a consuming industry, the total output X_j of that industry can be thought of as the sum of total inputs that have been used in producing X_j as follows:

$$X_j = X_{1j} + X_{2j} + X_{3j} + X_{4j} + X_{5j} + H_j U_j \quad (j = 1, \ldots, 5).$$

Similarly, considering household as a consuming sector in the exogenous system, the following identity can be formulated:

$$H = Y_{1h} + Y_{2h} + Y_{3h} + Y_{4h} + Y_{5h} + Y_{hh} + Y_{uh}.$$

Table 2 presents these outputs in tabular form, representing the inter-industry flow of goods and services obtained. One of the principal features of this transaction table is that total output and total input in each industry (including household) are necessarily equal since all sources of inputs and all sources of intermediate and final consumption have been recognized either explicitly or implicitly. The only other identity that follows from the transaction table is that total exports (Y_e) equals the sum of total unallocated imputs (U). This is necessarily so and will suggest possibilities of estimation of net exports after considering in detail the various items of inputs, such as imports and taxes, that make up the unallocated inputs.

The first five rows and the first five columns of the transaction table form the endogenous part of the input-output system (Model I). This will be utilized for developing the technical coefficients and interdependence coefficients in the succeeding paragraphs.

Matrix of Technical Coefficients

The technical coefficient of production is defined in economic theory as the amount of the output of industry i required to produce a unit of output of industry j. This is in conformity with the physical aspect of production. But in the context of input-output analysis the technical coefficient really represents the flow of goods from one local industry to produce a unit of output of another local industry. That is, it is possible in the context of input-output analysis that the technical coefficients may not represent the total requirements of one input. Indeed, there may very well be some imports from beyond the boundaries of the region. The importance of the nonlocal inputs may be appreciable in the analysis of any regional economy which is dependent on supplies from outside the region. In studies on a national scale, or in the analysis of regions which are almost self-sufficient in their input requirements, the flow coefficient or the technical coefficient (in the sense of physical production coefficient) may be one and the same, and no special

TABLE 2

Interindustry Flow of Goods and Services
Model I

		Consuming industry					Final demand		Total output
		1	2	3	4	5	Consumption (household)	Exports	
Producing industry	1	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	Y_{1h}	Y_{1e}	X_1
	2	X_{21}	X_{22}	X_{23}	X_{24}	X_{25}	Y_{2h}	Y_{2e}	X_2
	3	X_{31}	X_{32}	X_{33}	X_{34}	X_{35}	Y_{3h}	Y_{3e}	X_3
	4	X_{41}	X_{42}	X_{43}	X_{44}	X_{45}	Y_{4h}	Y_{4e}	X_4
	5	X_{51}	X_{52}	X_{53}	X_{54}	X_{55}	Y_{5h}	Y_{5e}	X_5
Household		H_1	H_2	H_3	H_4	H_5	Y_{hh}	Y_{he}	H
Unallocated inputs		U_1	U_2	U_3	U_4	U_5	Y_{uh}	a/	U
Total inputs		X_1	X_2	X_3	X_4	X_5	H	Y_e	

a/ Irrelevant combination.

problems may arise in treating the technical coefficients in the input-output framework.

In the analysis of small regions, such as San Benito County, nonlocal inputs are quite important. Technical coefficients then in fact represent the trade flows or trade relationships, that is, the amount of goods and services purchased from one local industry to produce a unit of output of another local industry.[1/] It is in this sense that the term "technical coefficient" will be used throughout this paper.

The above limitation need not be as serious as it seems initially. In an input-output analysis or a from-to trade-flow analysis of a particular region, attention is usually focused on the interflow of goods and services produced within its endogenous sectors; and the analysis may be supplemented with additional data on imports, capital formation, etc. However, the input-output technique has not yet been refined sufficiently to allow the inclusion of such data, nor does it yet permit the use of variable technical coefficients for practical application. Therefore, this limitation continues to exist and can be overcome only with supplemental analysis.

In Model I a set of constant quantities expressed in dollar terms, namely, a_{ij}, is defined as follows:

$$a_{ij} = \frac{X_{ij}}{X_j}$$

where X_{ij} represents the flow of goods and services from industry i to industry j that has been consumed in producing X_j.

Arranging the technical coefficients (a_{ij}) in a matrix form, the matrix of technical coefficients can be written as follows:

$$A = \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} & a_{15} \\ a_{21} & a_{22} & a_{23} & a_{24} & 2_{25} \\ a_{31} & a_{32} & a_{33} & a_{34} & a_{35} \\ a_{41} & a_{42} & a_{43} & a_{44} & a_{45} \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} \end{bmatrix}$$

1/ For a detailed discussion of the various aspects of input-output flows versus from-to flows in relation to regional and national economies, see C. L. Leven, "Regional Income and Product Accounts: Construction and Application," Design of Regional Accounts, ed. W. Hochwald (Baltimore: The Johns Hopkins Press, 1961), pp. 148-195.

Matrix of Interdependence Coefficients

The technical coefficients just discussed relate the output of one industry to the output of another and help to explain how much of the output of one industry was purchased to produce a given amount of output by another industry. The direct requirements of each industry for interindustry operations can thereby be estimated.

The interdependence coefficients, on the other hand, serve to explain the total direct and indirect requirements of each industry's output required to meet a given final demand. For example, they can show the overall business generated for the wholesale and retail sector by a dollar of sales made by agriculture to final demand. This includes the sales of the agriculture sector to itself to help produce a dollar's worth of output, as well as agriculture's sales to other sectors which were able to buy more because they could sell more to agriculture. These coefficients were used to develop output multipliers for the local economy.

To develop a precise definition of the interdependence coefficient and to express the relation with the technical coefficients, let us consider a set of constants B_{ij} ($i = j = 1, \ldots, 5$) where B_{ij} reflects the sum of the direct and indirect inputs of commodity i required by the economic system in order to deliver one dollar of output of industry j to the final demand sector. These B_{ij} coefficients, it should be noted, are independent of any changes in the nature and composition of the final demand sector; they are merely a means of evaluating the impact of a change in the final demand sector upon the output structure of the region that is less cumbersome than a round-by-round iterative procedure of evaluation. For example, any increase in final demand for agricultural products necessitates not only an increase in the output of agricultural products but, in turn, an increase in outputs of other industries which are suppliers to the agricultural industry and, hence, an increase in regional income and employment. All of this represents only the initial impact in the iterative procedure of evaluation. The final impact on the output structure needed to meet the given increase in final demand for agricultural products will involve additional rounds of evaluation of indirect requirements.

The mechanical process of computing the secondary effects of changes in final demand is reduced to a bare minimum when the interdependence coefficients are calculated as a function of known technical coefficients.

In this simplified procedure of evaluation of the impact of final demand, the interdependence coefficients are necessarily treated as constants, since they are based on constant technical coefficients. Hence, they are subject to the same limitation as the technical coefficients; that is, the trade flows relate to a single year--1961.

With the technical coefficients as a basis, the interindustry flow X_{ij} may be represented as follows:

$$X_{ij} = a_{ij}X_j.$$

That is, the value of i required to produce commodity j equals the value of i required to produce one dollar's worth of j multiplied by the total value of commodity j to be produced.

The total flow equations for the products of each industry may then be represented as follows:

$$X_i = \sum_{j=1}^{5} a_{ij}X_j + Y_i \qquad (i = 1, \ldots, 5)$$

where the first part on the right side of the equation represents the total requirements for the interindustry operations, and the second part (Y_i) represents the final demand.

In expanded form, after simple transposition of the terms, the flow equations become:

$$X_1 - a_{11}X_1 - a_{12}X_2 - a_{13}X_3 - a_{14}X_4 - a_{15}X_5 = Y_1$$
$$X_2 - a_{21}X_1 - a_{22}X_2 - a_{23}X_3 - a_{24}X_4 - a_{25}X_5 = Y_2$$
$$X_3 - a_{31}X_1 - a_{32}X_2 - a_{33}X_3 - a_{34}X_4 - a_{35}X_5 = Y_3$$
$$X_4 - a_{41}X_1 - a_{42}X_2 - a_{43}X_3 - a_{44}X_4 - a_{45}X_5 = Y_4$$
$$X_5 - a_{51}X_1 - a_{52}X_2 - a_{53}X_3 - a_{54}X_4 - a_{55}X_5 = Y_5$$

In matrix notation:

$$\begin{bmatrix} (1-a_{11}) & -a_{12} & -a_{13} & -a_{14} & -a_{15} \\ -a_{21} & (1-a_{22}) & -a_{23} & -a_{24} & -a_{25} \\ -a_{31} & -a_{32} & (1-a_{33}) & -a_{34} & -a_{35} \\ -a_{41} & -a_{42} & -a_{43} & (1-a_{44}) & -a_{45} \\ -a_{51} & -a_{52} & -a_{53} & -a_{54} & (1-a_{55}) \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \\ X_4 \\ X_5 \end{bmatrix} = \begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \\ Y_4 \\ Y_5 \end{bmatrix}$$

or

$$(I - A)\, X = Y.$$

$A_{(5 \times 5)} = \{a_{ij}\}$ = matrix of technical coefficients.

I = unit matrix (5×5).

X = column vector (5×1) $\begin{bmatrix} X_1 \\ X_5 \end{bmatrix}$.

Y = column vector (5×1) $\begin{bmatrix} Y_1 \\ Y_5 \end{bmatrix}$.

Solving for X in terms of Y, we have

$$X = (I - A)^{-1} Y = BY$$

where the matrix of interdependence coefficients, B, is given by

$$B = \begin{bmatrix} B_{11} & B_{12} & B_{13} & B_{14} & B_{15} \\ B_{21} & B_{22} & B_{23} & B_{24} & B_{25} \\ B_{31} & B_{32} & B_{33} & B_{34} & B_{35} \\ B_{41} & B_{42} & B_{43} & B_{44} & B_{45} \\ B_{51} & B_{52} & B_{53} & B_{54} & B_{55} \end{bmatrix} = \{B_{ij}\} \quad (I = j = 1, \ldots, 5).$$

With the use of these interdependence coefficients, B_{ij}, it becomes possible to trace the impact of a given change in the final demand sector on the output structure of the region.

Choice of Endogenous Sectors

One of the basic problems in input-output analysis is the choice of the endogenous sectors to be studied. This choice depends upon (1) the objectives of the study, (2) the costs and resources available for collection of detailed statistics on production and trading patterns of firms in the region, (3) the nature of data available through special surveys, and (4) the time required for analysis of basic data. Meaningful definitions of the sectors to be studied are particularly important in an interindustry analysis of small regions. For a small local community, such as San Benito County, trade flows defined in terms of monetary flows may be more meaningful than margins and at the same time are less cumbersome to develop within a relatively short period

of time. The industrial classification, however, may be made more elaborate by the use of many different economic sectors, depending upon several types of industrial activities. Similarly, the nonmanufacturing or service sectors may be defined with sufficient disaggregation. In this study, flow data were collected to correspond with available published sources of information on other variables, such as employment and income. It was considered desirable to limit the number of sectors so as to reduce cost and yet provide enough detail to permit the identification of important sectors. The choices were made after careful estimation of the usefulness of greater detail in relation to its cost. The economic survey was an invaluable source of information on some potential sectors and indicated others for which detail would be costly to develop (see Appendix B).

Final Demand Sectors

The levels and operations of final demand sectors are not explained by the input-output model itself. They are usually explained by exogenous factors that are determined outside the realm of influence of the endogenous sectors of the region. The various components of final demand will vary with the problem at hand, the region under study, its stage of development, and the cost of collecting information.

In the San Benito County models, final demand was defined to consist of one or both of the following two sectors: (1) sales to consumers (households) and (2) exports (sales to industries outside the County).

Sales to consumers consist of all direct sales to consumers (households), both within and outside the County. For lack of detailed information, it has been assumed in this analysis that sales by economic Sectors 1-4 to households represent sales to local consumers and that their direct sales to households outside the region are negligible. No such assumption was made regarding sales by Sector 5 (wholesale and retail).

Exports consist of all sales made to industries outside the County, as well as sales to all levels of government. The practice of treating government as an exogenous sector is common to most input-output studies because its level of operations is determined primarily by political and sociological

considerations and because adequate data on certain governmental operations are not always available.[1/]

If factors which influence the final demand components are not to be explained in the endogenous system, then an important issue must be resolved: whether or not to include or exclude the household sector in the structural matrix. If it is included in the structural matrix (as in Model II), the input-output model may then be used to study directly the changes in regional income and employment or population. On the other hand, if the household sector is excluded from the structural matrix (as in Model I), changes in regional income and employment may be studied outside the input-output framework explicitly, but only through more laborious, iterative methods.

The practical advantage of including the household sector in the structural matrix may often outweigh all other considerations, but a number of theoretical considerations arise. One of the important assumptions in the input-output model is the constancy of production coefficients. For the household sector, however, the constancy of technical or engineering relations may not hold between the level of household output (production of labor and other income-earning services) and household inputs (consumption expenditure). It may therefore be contended that the household sector should not be included in the structural matrix. On the other hand, household income and expenditure by type do bear constant ratios, and output of the household sector (personal income) and of other sectors in the region are also related. It has even been argued that both the household and local government sectors for urban areas can be treated as endogenous segments of the structural matrix on the assumption that activities of households and local governments are closely related to the general level of economic activity in the region.[2/]

The above arguments suggest that, on a purely conceptual basis, a final decision to include or exclude the household sector from the structural matrix

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1/ Armed with hindsight, the authors probably would have defined government as a separate sector were the study to be repeated. It appears to be of tremendous interest to local people. The failure to do so probably represents a carry-over from the classical mold of the input-output study as a reflection of physical flows.

2/ Werner Z. Hirsch, "Application of Input-Output Techniques to Urban Areas," Paper presented at the International Conference on Input-Output Techniques, Geneva, September 11-15, 1961, sponsored by Harvard Economics Research Project in association with the Secretary of the United Nations, 25p.

cannot be made at the present time. Therefore, for the purposes of this study, both analytical approaches were taken. In Model I, the household sector was treated as exogenous and excluded from the structural matrix but included in the final demand. In Model II, household was defined as endogenous and included in the structural matrix.

Residual (or Dummy) Sector

As in most other input-output studies, a dummy sector was created to handle residual elements. Information regarding the disposition of output seems to be readily obtainable from firms, but detailed input information is more difficult to secure. Each firm within a region is both a producing unit and a consuming unit, and one firm's output sold to another firm becomes the latter's input in producing its product. If the total output of an industry is assumed to be equal to the sum total of inputs, measured in dollar values, the residual sector then represents the difference between total output of an industry minus the contribution of the locally produced inputs of economic Sectors 1-5.

The residual sector therefore consists of the following groups of items:[1/]

1. Contribution of wages, salaries, and other labor income.

2. Proprietors' income, including profits.

3. Nonlabor items such as interest, dividends, and taxes.

4. Inputs imported from outside the region for local interindustry demand or local final consumption. For example, the residual elements for Sectors 1-4 partially represent imports for use in the firm, and for Sector 5 (wholesale and retail) they are primarily imports of commodities for resale.

In our two models these four groups were then aggregated into the following two components:

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1/ A comprehensive study treating these individual components separately would require a major study of the procurement and cost structure of individual firms and industries in the region and availability of confidential information on profits and taxes, etc. Such an elaborate treatment is beyond the scope of the present study. Information collected in the survey relating to the input structure of firms was used as a check on the accuracy and consistency of output figures (see Appendix B).

1. Household income consisting of wages and salaries; proprietors' income, including profits; and other labor income. This component was treated as exogenous in Model I and as endogenous in Model II.

2. Unallocated inputs consisting of taxes and imports from outside the region for local interindustry demand or final consumption. This component was treated as exogenous in both the models.

The above classification was governed almost entirely by the nature of data available on types of personal income.

General Assumptions of the Model

Input-output analysis can be carried out by formulating the model in two distinct ways--the "Leontief Open System" or simply the "open system" and the "Walras-Leontief Closed System" or simply the "closed system."[1/]

Both systems have been subject to criticism for assuming the constancy of technical coefficients, that is, that the amount of a particular local input used in producing a unit of product j remains fixed. Problems connected with capital formation are usually ignored in the transaction matrix because of data difficulties, and the economic system is explained purely in terms of static conditions without explicitly incorporating changes in technology brought about by internal economies of scale, external economies due to urbanization, or changes in relative prices of commodities. The main criticism leveled against the application of input-output analysis is that the inability to foresee technological change makes it impossible to adopt variable technical or trade coefficients, especially when capital investment is included as an endogenous sector. But the same criticism seems to be applicable to any other social science technique which, of necessity, has to proceed in the face of uncertainty regarding future technological changes. Any projections made of the output structure of a dynamic economic region must therefore be subject to these limitations.[2/]

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1/ For a discussion of the difference between the two systems, see R. G. D. Allen, Mathematical Economics (2d ed.; New York: St. Martin's Press, Inc., 1959), pp. 348-349 and 358-359.

2/ See Walter Isard, et al., Methods of Regional Analysis, an Introduction to Regional Science ("Regional Science Studies," Vol. II; New York: Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, Inc., 1960), p. 341.

The ideal open system can be briefly defined in the following terms: A specified number of homogeneous industries are in operation in an economy, each limited to the production of a single and different commodity, thereby avoiding instability in the technical coefficients included in the endogenous system. Such sectors as household, government, investment (capital formation), and external trade (exports) are not uaually included in the endogenous system but are treated as part of the final demand assumed to be given to the system. Wage costs are also assumed to be given.

The open system becomes a closed system when all sectors are defined as endogenous, including those previously treated as outside the system. In the closed system, the structure of the input-output model is expanded to include as many rows and columns as there are additional sectors; and now all the sectors, including such final consumers as household and government, become intermediate consumers. The layer of distinction between intermediate consumption and final consumption thus disappears, and the additional sectors that are brought into the closed system also become subject to the assumption of constancy of production coefficients.

The models adopted in this analysis of the San Benito County economy fall within the open system and are therefore subject to the general criticisms just discussed.

Summary of Differences Between Model I and Model II

As previously stated, in Model I the output of the household sector is treated as exogenous; that is, labor is assumed to be given to the economic system and not produced within the endogenous system. Changes in household consumption--that is, consumption of most of the output of the nonmanufacturing and business services sector and the trade sector--is assumed to be determined exogenously, or outside the input-output system. Finally, the supply of labor used in the local production of goods and services is also assumed to be given to the system. In other words, changes in labor use and volume of business due to household expenditures are not automatically indicated by the input-output system but must be dealt with specifically.

In Model II the household sector is treated as an endogenous sector, producing labor and supplying it to other industries. In this approach household is defined as an intermediate sector and is excluded from final demand.

No longer a part of final consumption, household consumption is instead treated as an input for the production of labor. Model II can therefore be used to study directly and simultaneously the effects of given changes in exports on the production of local output, employment, income, and final household consumption.

The distinction between Model I and Model II has two important consequences. First, by definition, final demand in Model I will be larger than in Model II, since it includes the household sector. Second, the interdependence coefficients in Model II will be somewhat higher than those in Model I, because the indirect effects upon the output of the local economy are explicitly recognized and not left to estimation outside the model. Since household was not a part of the endogenous system in Model I but given to the system exogenously, no indirect local inputs were involved in producing the labor supply.

Model I is the form usually used in national and statewide studies, probably because it is more applicable to the larger economy. Labor cannot readily flow into so large a defined region, and it becomes unrealistic to think of increases in consumption as producing labor. Labor supply is determined outside the economic system in a cause and effect sense. Model II, on the other hand, is more reasonably applicable to small areas, such as the county, which permits freer mobility of households. Furthermore, businessmen and local officials would probably have a deeper interest in the economic impact of the household sector as demonstrated in the results of Model II.

RESULTS OF INPUT-OUTPUT MODELS I AND II

Technical Coefficients

Table 3 shows the technical coefficients for each of the producing sectors in the San Benito County economy. Reading down each of the columns, the figures represent the proportion of direct purchases made from each of the row sectors for producing a dollar of output of the column sector. These coefficients are calculated directly from Table 1, describing the interindustry flows.

The first five rows and columns are used in Model I; the first six rows and columns (including household) are used in Model II. The residual

Model I

TABLE 3

Technical Coefficients, Models I and II, San Benito County Economy, 1961[a/]

Producing sectors	Purchasing sectors: Agriculture	Food processing	Manufacturing	Nonmanufacturing, including business services	Wholesale and retail	Household (consumer)
	1	2	3	4	5	6
1. Agriculture	.133582	.283729	b/	b/	.009189	b/
2. Food processing	.059076	.000376	.000151	b/	.000780	b/
3. Manufacturing	.010380	.000601	.005571	.005274	.000130	.005771
4. Nonmanufacturing, including business services	.039212	.128681	.297396	.266060	.023972	.134667
5. Wholesale and retail	.147030	.006535	.002560	.011201	.008843	.447483
6. Household (labor)	.413769	.202825	.400240	.477523	.095925	.136247
Unallocated inputs	.196951	.377253	.294082	.239942	.861161	.275832
Total inputs	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000

(Continued on next page.)

TABLE 3--continued.

Model (2)

Producing sectors	Purchasing sectors: Agriculture	Food processing	Manufacturing	Nonmanufacturing, including business services	Wholesale and retail	Household (consumer)
	1	2	3	4	5	6
Model I						
Total endogenous inputs (sum of rows 1-5)	.389280	.419922	.305678	.282535	.042914	c/
Total residual inputs (sum of row 6 and unallocated inputs)	.610720	.580078	.694322	.717465	.957086	c/
Model II						
Total endogenous inputs (sum of rows 1-6)	.803049	.622747	.705918	.760058	.138839	.724168
Total residual inputs (same as unallocated inputs)	.196951	.377253	.294082	.239942	.861161	.275832

a/ The technical coefficients are calculated on the basis of the data presented in Table 1. Each technical coefficient shows in dollar terms the direct input requirements from the row sector for producing one unit of output of the column sector.

b/ Negligible.

c/ Household is not included as an endogenous sector in Model I.

"unallocated inputs" complete the statistical description of the input structure. The table thus describes separately the total endogenous inputs drawn from the several economic sectors within the region for Models I and II.

The direct output multiplier effects, as we shall see, are large for food processing and agriculture since these two sectors, considered jointly, draw their direct inputs from almost all of the endogenous sectors. Similar direct effects for the manufacturing industry, though appreciable, are not quite as pronounced as for food processing and agriculture. However, the direct output multiplier effects may change with changing patterns of trade if the unallocated input coefficients are large. In other words, items formerly imported may be produced locally. But, as stressed earlier, the unallocated input coefficients consist of a variety of factors not exclusively purchases from outside the region. Nonetheless, this would seem to indicate a potential source of future growth as existing industries expand.

Interdependence Coefficients

The interdependence coefficients describe both direct and indirect requirements of the local economy in order to meet a dollar's worth of additional final demand for products produced in the local economy.

At this point it should be emphasized that the direct relations described by the technical coefficients relate to a change of $1.00 in the production of output of the endogenous sector regardless of whether it goes to final demand or is used in the endogenous system. The interdependence coefficients, on the other hand, relate solely to a dollar change in final demand for the products and services of the endogenous sector. This distinction should be clearly borne in mind when technical coefficients and interdependence coefficients are compared because the impact on the local economy corresponding to a change in the production of $1.00 of output of an industry is not the same as the impact corresponding to a change of $1.00 of output delivered to the final demand sector. For the interdependence coefficients as presented here to be comparable to the technical coefficients, they should be reduced by the proportion final demand is to output.

The interdependence coefficients for Models I and II are given in Table 4. In the agriculture, food processing, and manufacturing industries, they are similar in both models. For the nonmanufacturing, including business services,

TABLE 4

Interdependence Coefficients, Models I and II, San Benito County Economy, 1961[a/]

Producing sectors	Purchasing sectors: Agriculture	Food processing	Manufacturing	Nonmanufacturing, including business services	Wholesale and retail	Household (consumer)
	1	2	3	4	5	6
1. Agriculture						
Model I	1.178908	.334711	.000131	.000171	.011197	[b/]
Model II	1.182866	.337856	.004327	.004770	.012025	.007003
2. Food processing						
Model I	.069810	1.020203	.000165	.000023	.001450	
Model II	.070324	1.020611	.000710	.000620	.001558	.000908
3. Manufacturing						
Model I	.012829	.005183	1.007771	.007248	.000430	
Model II	.018320	.009545	1.013593	.013628	.001580	.009715
4. Nonmanufacturing, including business services						
Model I	.086183	.200769	.408626	1.365965	.034046	
Model II	.244624	.326643	.576628	1.550082	.067221	.280350
5. Wholesale and retail						
Model I	.176348	.058660	.007241	.015481	1.010978	
Model II	.533669	.342532	.386122	.430703	1.085795	.632246
6. Household (labor)						
Model I						
Model II	.786145	.624550	.833581	.913536	.164606	1.391013
Total						
Model I	1.524078	1.619526	1.423934	1.388888	1.058101	
Model II	2.835948	2.661737	2.814961	2.913339	1.332785	2.321235

a/ The interdependence coefficients given in this table correspond to the "B" matrix explained in the theoretical formulation of the models.

b/ Blanks indicate household was not included as an endogenous sector in Model I.

sector and for the wholesale and retail sector, the coefficients are lower in Model I than in Model II, a result to be expected with the inclusion of household as an endogenous sector in Model II.

Interdependence coefficients can also be expressed in terms of their employment equivalents; that is, the effects of increases in direct and indirect output requirements upon employment in each industry can also be studied with the help of the interdependence coefficients and (1961) labor/output ratios. However, in reality, employment effects may not be due in the same degree to increases in the efficiency of labor among the various producing industries. Since, at this stage of analysis, no specific assumptions have been made about the possible future rate of growth in efficiency of labor, the remainder of this discussion of direct and indirect dependence among the sectors is related to changes in output rather than employment.1/

Future projections of growth will be discussed in greater detail at a later point, and employment forecasts will be attempted which will take into account the different growth rates in the efficiency of labor.2/

The technical coefficients given in Table 3 and the interdependence coefficients given in Table 4 can be used in a variety of ways to discuss the relative importance of indirect to direct effects of changes in final demand for the products and services produced in San Benito County. Tables 5 and 6 summarize the indirect effects and their importance relative to direct effects, both for Model I and Model II.

Direct and Indirect Dependence Among the Economic Sectors

The following discussion deals primarily with Model II results, since this is probably of greater interest to local people, and some important differences from Model I are briefly noted. The reader is advised that, for the benefit of all interested readers, the discussion of direct and indirect dependence among sectors is detailed and exhaustive. The description is similar for each sector, and important differences are brought out as they occur. If they so desire, readers may therefore limit their attention to only those sectors in which they are particularly interested.

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1/ For those interested in employment effects, some conversion data are presented in Appendix D.

2/ See tables and explanatory notes in Appendix E.

TABLE 5

Indirect Requirements of the Purchasing Sectors, Models I and II[a]
San Benito County, 1961

Producing sectors	Purchasing sectors: Agriculture	Food processing	Manufacturing	Nonmanufacturing, including business services	Wholesale and retail	Household (consumer)
	1	2	3	4	5	6
1. Agriculture						
Model I	.045326	.050982	.000131[b]	.000171[b]	.002008	[c]
Model II	.049284	.054127	.004327[b]	.004770[b]	.002836	.007003
2. Food processing						
Model I	.010734	.019827	.000014	.000023[b]	.000670	
Model II	.011248	.020235	.000559	.000620[b]	.000778	.000908
3. Manufacturing						
Model I	.002449	.004582	.002200	.001974	.000300	
Model II	.007940	.008944	.008022	.008354	.001450	.003944
4. Nonmanufacturing, including business services						
Model I	.046971	.072088	.111230	.099905	.010074	
Model II	.205412	.197962	.279232	.284022	.043249	.145683
5. Wholesale and retail						
Model I	.029318	.052125	.004681	.004280	.002135	
Model II	.386639	.335997	.383562	.419502	.076952	.184763
6. Household (labor)						
Model I						
Model II	.372376	.421725	.433341	.436013	.068681	.254766

(Continued on next page.)

TABLE 5--continued.

a/ The indirect requirements were obtained as follows:

For those elements which are not in the diagonal, the indirect requirements are calculated as: $(B_{ij} - a_{ij})$, where $i \neq j$.

For the elements in the diagonal, the indirect requirements are calculated as: $(B_{ii} - a_{ii} - 1)$, where the interdependence coefficients are represented by B and the technical coefficients are represented by a. For further details, see H. B. Chenery and P. G. Clark, Interindustry Economics (New York: John Wiley & Sons, Inc., 1959), 845p.

b/ These figures are the same as the corresponding interdependence coefficients, as the direct requirements were negligible in these cases.

c/ Blanks indicate household was not included as an endogenous sector in Model I.

TABLE 6

Ratios of Indirect to Direct Requirements of the Purchasing Sectors, Models I and II[a/]
San Benito County, 1961

Producing sectors	Purchasing sectors: Agriculture	Food processing	Manufacturing	Nonmanufacturing, including business services	Wholesale and retail	Household (consumer)
	1	2	3	4	5	6
1. Agriculture						
Model I	.04	.18	--[b/]	--	.22	[c/]
Model II	.04	.19	--	--	.31	--
2. Food processing						
Model I	.18	.02	.09	--	.86	
Model II	.19	.02	3.70	--	1.00	--
3. Manufacturing						
Model I	.24	7.62	0	.37	2.31	
Model II	.76	14.88	.01	1.58	11.16	.68
4. Nonmanufacturing, including business services						
Model I	1.20	.56	.37	.08	.42	
Model II	5.24	1.54	.94	.22	1.80	1.08
5. Wholesale and retail						
Model I	.19	8.00	1.83	.38	0	
Model II	2.63	51.42	149.82	37.45	.08	.41
6. Household (labor)						
Model I						
Model II	.90	2.08	1.08	.91	.72	.22

a/ Ratios are obtained by using the indirect requirements (Table 5) and the corresponding direct requirements (technical coefficients, Table 3). For details, see H. B. Chenery and P. G. Clark, Interindustry Economics (New York: John Wiley & Sons, Inc., 1959), 845p.

b/ Dashes indicate ratios were not calculated since direct requirements were zeros.

c/ Blanks indicate household was not included as an endogenous sector in Model I.

Sector 1--Agriculture

Agriculture ranks second in use of locally produced goods (nearly 39 cents worth of goods and services per dollar of output). The direct inputs come from each industry in appreciable quantities, except from manufacturing. As shown in Table 7, agriculture uses 13 cents of its own goods, 6 cents from the food processing sector, about 1 cent from manufacturing, 4 cents from nonmanufacturing, and about 15 cents from wholesale and retail. The largest input is from the household sector, about 41 cents. Since the inputs come from all of the endogenous sectors, the output multiplier effect is appreciable when the indirect effects are taken into account.

In order that the local agricultural sector may deliver an additional $1 million of its output to final demand (exports outside the County), while holding the final demand for the output of other industries at its initial (1961) level, the following direct and indirect output composition is required in the local economy (see Table 7, column 3): agriculture, $1.18 million ($1 million for delivery to final demand and $0.18 million of generated internal flows among the endogenous sectors); food processing, $70,300; manufacturing, $18,300; nonmanufacturing, including business services, $244,600; wholesale and retail, $533,700; and household expenditure, $786,100.

Model I gives similar results as above except for the nonmanufacturing, including business services, sector and wholesale and retail. In these two sectors, the output requirements are somewhat low because household is excluded from the endogenous system (see Table 7, column 2).

The ratios of indirect to direct requirements given in columns 6 and 7 in Table 7 indicate the importance of the indirect effects compared to the corresponding direct effects upon the output of each sector. The indirect effects upon the nonmanufacturing, including business services sector, are appreciable--nearly $205,400, or five times the direct effects--even though its direct input into agriculture was relatively small (4 percent). This can be partially explained by the fact that agriculture draws a large input from household (41 percent); and household, in turn, draws an appreciable direct input from nonmanufacturing (27 percent). Finally, the direct and indirect effects on wholesale and retail are large--nearly $533,700--largely because the input into agriculture from that sector is large (15 percent).

TABLE 7

Sector 1--Agriculture: Comparison of Direct and Indirect Requirements, Models I and II
San Benito County, 1961

Producing sectors	Technical coefficient	Interdependence coefficient		Indirect requirement		Ratio (indirect to direct)[a]	
		Model I	Model II	Model I	Model II	Model I	Model II
	1	2	3	4	5	6	7
1. Agriculture	.1336	1.1789	1.1829	.0453	.0493	.04	.04
2. Food processing	.0591	.0698	.0703	.0107	.0112	.18	.19
3. Manufacturing	.0104	.0128	.0183	.0024	.0079	.24	.76
4. Nonmanufacturing, including business services	.0392	.0862	.2446	.0470	.2054	1.20	5.24
5. Wholesale and retail	.1470	.1763	.5337	.0293	.3866	.19	2.63
6. Household (labor)	.4138	[b]	.7861	[b]	.3724	[b]	.90

[a] For the agriculture row, the ratio of indirect to direct requirements for Model I is $\frac{.0453}{1.1336}$; for Model II, $\frac{.0493}{1.1336}$. For all other rows, ratios were computed as follows: Model I = $\frac{\text{column 4}}{\text{column 1}}$; Model II = $\frac{\text{column 5}}{\text{column 1}}$.

[b] Household was not included as an endogenous sector in Model I.

Sources: Tables 3-6.

Sector 2--Food Processing

Of the five producing sectors in San Benito County, the food processing sector requires the largest amount of direct inputs (nearly 42 cents) for producing a dollar's worth of its output. As shown in Table 8, a large proportion of this input comes from agriculture (28 cents) and nonmanufacturing, including business services (13 cents). Direct inputs from the other three sectors are very low. The household input is nearly 20 cents. The pattern of dependence is similar to the California economy.

In order that the food processing sector may deliver an additional $1 million of its output to final demand (exports outside the County), while holding the final demand for output of all the other industries at its initial (1961) level, the following direct and indirect output composition is required in the local economy (see Table 8, column 3): agriculture, $337,900; food processing, $1.0206 million ($1 million for delivery to final demand and $20,600 of generated internal flows among the endogenous sectors); manufacturing, $9,500; nonmanufacturing, including business services, $326,600; wholesale and retail, $342,500; and household, $624,600.

Model I gives results similar to these, with the exception of the nonmanufacturing and wholesale and retail sectors in which the direct and indirect output requirements are somewhat lower as a result of the exclusion of the household sector from the endogenous system.

The manufacturing and wholesale and retail ratios are surprisingly large, even though the food processing industry uses very little local input from each of these sectors. A partial explanation may be found in the following.

Although the indirect/direct ratio for manufacturing is large--nearly 15:1 (nearly 8:1 in Model I)--in actual dollar terms, the sum of direct and indirect effects on manufacturing is not appreciable. It is less than $10,000, or under 1 percent of the change in demand for food processing.

The surprisingly large ratio for wholesale and retail requires a more complex explanation, especially in Model II. While food processing does not have large inputs from the local wholesale and retail sector, it does receive large inputs from agriculture, nonmanufacturing, and household. Of these, the agriculture and household sectors themselves have large direct inputs from the wholesale and retail sector, amounting to nearly 90 percent of its total sales. Thus, the explanation for large indirect to direct effect in the wholesale and

TABLE 8

Sector 2--Food Processing: Comparison of Direct and Indirect Requirements, Models I and II
San Benito County, 1961

Producing sectors	Technical coeffi-cient	Interdependence coefficient		Indirect requirement		Ratio (indirect to direct)[a]	
		Model I	Model II	Model I	Model II	Model I	Model II
	1	2	3	4	5	6	7
1. Agriculture	.2837	.3347	.3379	.0510	.0541	.18	.19
2. Food processing	.0004	1.0202	1.0206	.0198	.0202	.02	.02
3. Manufacturing	.0006	.0052	.0095	.0046	.0089	7.62	14.88
4. Nonmanufacturing, including business services	.1287	.2008	.3266	.0721	.1980	.56	1.54
5. Wholesale and retail	.0065	.0587	.3425	.0521	.3360	8.00	51.42
6. Household (labor)	.2028	[b]	.6246	[b]	.4217	[b]	2.08

[a] For the food processing row, the ratio of indirect to direct requirements for Model I is $\frac{.0198}{1.0004}$; for Model II, $\frac{.0202}{1.0004}$. For all other rows, ratios were computed as follows: Model I = $\frac{\text{column 4}}{\text{column 1}}$; Model II = $\frac{\text{column 5}}{\text{column 1}}$.

[b] Household was not included as an endogenous sector in Model I.

Sources: Tables 3, 4, 5, and 6.

retail sector lies largely in the generated (indirect) flows of local agriculture and household, which supply large inputs into food processing and consume a large portion of sales of the wholesale and retail sector.

Sector 3--Manufacturing

The manufacturing sector ranks third in use of the total direct inputs from the five producing sectors. According to Table 9, it uses more than 30 cents of locally produced inputs, almost all of which come from the nonmanufacturing sector. Direct input from household is slightly over 40 cents.

In order that the local manufacturing sector may deliver an additional $1 million of its output to final demand (exports outside the County) while holding the final demand for the output of all the other industries at its initial (1961) level, the following direct and indirect output composition is required in the local economy (see Table 9, column 3): agriculture, $4,300; food processing, $700; manufacturing, $1.0136 million ($1 million for delivery to final demand and $13,600 of generated internal flows among the endogenous sectors); nonmanufacturing, including business services, $576,600; wholesale and retail, $386,100; and household, $833,600.

Similar results are obtained for Model I, except for the nonmanufacturing and wholesale and retail sectors in which the output requirements are somewhat lower, again because of the exclusion of household sector from the endogenous system.

An examination of the ratios of indirect/direct requirements reveals a surprisingly large indirect effect on the wholesale and retail sector ($383,600), which was not immediately apparent since manufacturing draws very small direct inputs from this sector. Explanation for the large indirect effect on wholesale and retail lies indirectly through the household sector, which draws a large input from wholesale and retail and supplies labor inputs into manufacturing.

Sector 4--Nonmanufacturing, Including Business Services

This sector uses about 28 cents worth of locally produced inputs from the five producing sectors. Nearly all of these direct inputs, according to Table 10, come from the nonmanufacturing sector itself, and its direct household input of 48 cents is higher than that of all other sectors.

TABLE 9

Sector 3--Manufacturing: Comparison of Direct and Indirect Requirements, Models I and II
San Benito County, 1961

Producing sectors	Technical coeffi-cient	Interdependence coefficient		Indirect requirement		Ratio (indirect to direct)[a]	
		Model I	Model II	Model I	Model II	Model I	Model II
	1	2	3	4	5	6	7
1. Agriculture	b/	.0001	.0043	.0001	.0043	c/	c/
2. Food processing	.0002	.0002	.0007	0	.0006	.09	3.70
3. Manufacturing	.0056	1.0078	1.0136	.0022	.0080	0	.01
4. Nonmanufacturing, including business services	.2974	.4086	.5766	.1112	.2792	.37	.94
5. Wholesale and retail	.0026	.0072	.3861	.0047	.3836	1.83	149.82
6. Household (labor)	.4002	d/	.8336	d/	.4333	d/	1.08

a/ For the manufacturing row, the ratio of indirect to direct requirements for Model I is $\frac{.0022}{1.0056}$; for Model II, $\frac{.0080}{1.0056}$. For all other rows, ratios were computed as follows: Model I = $\frac{\text{column 4}}{\text{column 1}}$; Model II = $\frac{\text{column 5}}{\text{column 1}}$.

b/ Negligible.

c/ Ratios were not calculated since direct requirements were negligible.

d/ Household was not included as an endogenous sector in Model I.

Sources: Tables 3, 4, 5, and 6.

TABLE 10

Sector 4--Nonmanufacturing, Including Business Services: Comparison of Direct and Indirect Requirements, Models I and II, San Benito County, 1961

Producing sectors	Technical coefficient	Interdependence coefficient		Indirect requirement		Ratio (indirect to direct)[a/]	
		Model I	Model II	Model I	Model II	Model I	Model II
	1	2	3	4	5	6	7
1. Agriculture	b/	.0002	.0048	.0002	.0048	c/	c/
2. Food processing	b/	0	.0006	0	.0006	c/	c/
3. Manufacturing	.0053	.0072	.0136	.0020	.0084	.37	1.58
4. Nonmanufacturing, including business services	.2661	1.3660	1.5501	.0999	.2840	.08	.22
5. Wholesale and retail	.0112	.0155	.4307	.0043	.4195	.38	37.45
6. Household (labor)	.4775	d/	.9135	d/	.4360	d/	.91

a/ For the nonmanufacturing, including business services, row, the ratio of indirect to direct requirements for Model I is $\frac{.0999}{1.2661}$; for Model II, $\frac{.2840}{1.2661}$. For all other rows, ratios were computed as follows: Model I = $\frac{\text{column 4}}{\text{column 1}}$; Model II = $\frac{\text{column 5}}{\text{column 1}}$.

b/ Negligible.

c/ Ratios were not calculated since direct requirements were negligible.

d/ Household was not included as an endogenous sector in Model I.

Sources: Tables 3, 4, 7, and 8.

In order that the local nonmanufacturing, including business services, sector may deliver $1 million of its products and services to the final demand sector (exports outside the County) while holding the final demand for the output of the other industries at its initial (1961) level, the following direct and indirect output composition is required in the local economy (see Table 10, column 3): agriculture, $4,800; food processing, $600; manufacturing, $13,600; nonmanufacturing, including business services, $1.5501 million ($1 million for delivery to the final demand sector and $550,100 for generated internal flows among the endogenous sectors); wholesale and retail sector, $430,700; and household, $913,500.

Once again, Model I gives similar results except for lower indirect requirements for the nonmanufacturing and wholesale and retail sectors.

The ratios of indirect/direct requirements would suggest that the huge indirect requirements within the nonmanufacturing sector itself may be due to the large direct input from within the sector. The indirect effects on the output of the wholesale and retail sector are an appreciable $419,500, even though its corresponding direct input into the nonmanufacturing sector amounts to only 2 percent. Partial explanation for large indirect effects on the wholesale sector may be found in a large direct household input into the nonmanufacturing sector.

Sector 5--Wholesale and Retail

As shown in Table 11, this sector consumes only about 4 cents per dollar of the output of the local producing sectors. This is accounted for by the large proportion of unallocated inputs into this sector, some 86 cents, which consists mostly of goods imported from outside for resale (see Table 3, column 5).

If the local wholesale and retail sector were to increase its sales by $1 million to households and/or outside the County, the results of Model I would indicate that the indirect effects upon itself would be very small--about 1 percent. Since the largest single direct local input into the wholesale and retail sector consists of household (about 10 percent), any additional indirect effects on the wholesale and retail sector would very likely be felt through the household sector. In Model II the indirect effect within the wholesale and retail sector is greater--about $86,000. This is amply explained by the large household input.

TABLE 11

Sector 5--Wholesale and Retail: Comparison of Direct and Indirect Requirements, Models I and II
San Benito County, 1961

Producing sectors	Technical coefficient	Interdependence coefficient		Indirect requirement		Ratio (indirect to direct)[a]	
		Model I	Model II	Model I	Model II	Model I	Model II
	1	2	3	4	5	6	7
1. Agriculture	.0092	.0112	.0120	.0020	.0028	.22	.31
2. Food processing	.0008	.0015	.0016	.0007	.0008	.86	1.00
3. Manufacturing	.0001	.0004	.0016	.0003	.0014	2.31	11.16
4. Nonmanufacturing, including business services	.0240	.0340	.0672	.0101	.0432	.42	1.80
5. Wholesale and retail	.0088	1.0110	1.0858	.0021	.0770	0	.08
6. Household (labor)	.0959	[b]	.1646	[b]	.0687	[b]	.72

[a] For the wholesale and retail row, the ratio of indirect to direct requirements for Model I is $\frac{.0021}{1.0088}$; for Model II, $\frac{.0770}{1.0088}$. For all other rows, ratios were computed as follows: Model I = $\frac{\text{column 4}}{\text{column 1}}$; Model II = $\frac{\text{column 5}}{\text{column 1}}$.

[b] Household was not included as an endogenous sector in Model I.

Sources: Tables 3, 4, 5, and 6.

It should be noted that any increase in sales of this sector, either directly or indirectly, will probably result in large imports into the County for resale. This is confirmed by the observation that none of the other sectors sell very much output to local retail firms.

Sector 6--Household (Labor)

The household (labor) sector requires a somewhat different interpretation, for its output takes the form of labor measured as personal income, while final consumption represents its inputs.

As seen in Table 12, the direct dependence of household on the output of other local producing sectors is as expected. For example, direct purchases from agriculture, food processing, and manufacturing by the household sector (as inputs) are negligible; whereas purchases from wholesale and retail are very large (nearly 45 cents). The input from the household sector itself is nearly 14 cents.

The interdependence coefficients indicate that if the household net output (personal income less taxes and savings) were to increase by $1 million through the export of labor, the following direct and indirect requirements of output composition are required in the economy: an increase of $1.39 million in the household sector itself ($1 million net increase in household personal income and $0.39 million of internal generated income within the household sector; $632,000 in the wholesale and retail sector; and $280,400 in the nonmanufacturing, including business services, sector. The direct and indirect effects on other sectors are negligible compared to the effect on the service industries.

APPLICATION OF INPUT-OUTPUT RESULTS

Effects of Proportional Changes in Final Demand on Output of Agriculture and Nonagriculture: Comparison of San Benito County (Model I) and California

The direct and indirect requirements discussed so far can be used in a variety of ways to study the effects of growth on the local economy. A comparison of San Benito County with California in the interdependence between agriculture and nonagriculture may be of considerable interest. The effects of a percentage change in final demand are shown in Table 13 for San Benito County (Model I) and in Table 14 for the California economy (1954).

TABLE 12

Sector 6--Household (Labor): Direct and Indirect Requirements
Model II, San Benito County, 1961

Producing sectors	Technical coefficient	Interdependence coefficient	Indirect requirement	Ratio (indirect to direct)[a]
		Model II		
	1	2	3	4
1. Agriculture	[b]	.0070	.0070	[c]
2. Food processing	[b]	.0009	.0009	[c]
3. Manufacturing	.0058	.0097	.0039	.68
4. Nonmanufacturing, including business services	.1347	.2804	.1457	1.08
5. Wholesale and retail	.4475	.6322	.1847	.41
6. Household (labor)	.1362	1.3910	.2548	.22

[a] For the household (labor) row, the ratio of indirect to direct requirements = $\frac{.2548}{1.1362}$; for other sectors, $\frac{\text{column 3}}{\text{column 1}}$.

[b] Negligible.

[c] Ratios were not calculated since direct requirements are zero.

Sources: Tables 3, 4, 5, and 6.

TABLE 13

Agriculture Versus Industry: Output Effects Resulting from a Proportional Change in Final Demand Model I, San Benito County, 1961

	1961		Change in output resulting from a 10 percent change in final demand for:		
	Output	Final demand	Agriculture and food processing	Other industries[a]	Total
	1	2	3	4	5
	thousand dollars				
Agriculture	21,193	14,373	2,097 (9.89)[b]	22 (0.10)	2,119 (9.99)
Food processing	13,312	12,036	1,329 (9.98)	3 (0.02)	1,332 (10.00)
Agriculture and food processing	34,505	26,409	3,426 (9.93)	25 (0.07)	3,451 (10.00)
Other industries[a]	49,620	36,231	715 (1.44)	4,248 (8.56)	4,963 (10.00)

a/ Includes Sectors 3, 4, and 5.

b/ Figures in parentheses indicate percentage change.

TABLE 14

Agriculture Versus Industry: Output Effects Resulting from Changes in Final Demand California, 1954

	1954		Percent change in output resulting from a 10 percent change in final demand for:		
	Output	Final demand	Agriculture plus agricultural processing	Other industry	Total
	thousand dollars				
Agriculture	2,915,178	1,112,606	a/	0.78	
Agricultural processing	4,949,000	3,395,844		1.34	
Agriculture plus agricultural processing	7,864,178	4,508,450	8.86	1.14	10.0
Other industry	42,474,256	26,182,057	0.50	9.50	10.0

a/ Blanks indicate irrelevant combinations.

Source: William E. Martin and Harold O. Carter, A California Interindustry Analysis Emphasizing Agriculture. Part I: The Input-Output Models and Results, University of California, Giannini Foundation Research Report No. 250 (Berkeley, 1962), p. 45.

A 10 percent change in final demand for products of agriculture and the food processing industry in San Benito County induces nearly 9.93 percent change in the direct and indirect output requirements from agriculture and food processing and 1.44 percent in the output of other industries (nonagriculture). A similar change in final demand for nonagriculture induces only a 0.07 percent change in output of agriculture and food processing and an 8.56 percent change in nonagriculture; that is, a change in final demand for products of agriculture induces a greater percentage change in output of nonagriculture than a similar change in final demand for nonagriculture induces in the output of agriculture. This result is exactly the opposite of that shown in Table 14 for the California economy. In California, the effect on industry output of final demand changes in agriculture is not as great as the effect on agriculture of final demand changes in industry. These opposite results can be explained in part by the following contrasting conditions:

1. In San Benito County, agriculture supplies less input into nonagriculture (omitting food processing) than in the state as a whole.

2. Nonagriculture (especially manufacturing) supplies a negligible quantity of its output as input into agriculture.

3. The output of agriculture and food processing ($34.5 million) is nearly five times the output of manufacturing industries ($6.6 million) in San Benito County, whereas California's output of agriculture and food processing ($7,864.1 million) is less than half of the output of manufacturing ($18,085.3 million).[1/]

Effects of Changes in Final Demand on Output, Employment, and Income in the San Benito County Economy

Models I and II

Models I and II for San Benito County are compared in Table 15, which reflects changes in the output, employment, and income corresponding to a 10 percent change in final demand for the products of the following groups of economic sectors: (1) agriculture and food processing; (2) manufacturing, nonmanufacturing, and wholesale and retail; (3) all five endogenous sectors of Model I; and (4) household. In this discussion emphasis is placed on comparisons of like percentage changes among the sectors within the County; for

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1/ For California data, see Martin and Carter, A California Interindustry Analysis. . . . Part I. . . .

TABLE 15

Impact on Regional Output, Employment, and Household (Labor) Income Induced by Changes in Final Demand
Models I and II, San Benito County, 1961

	10 percent change in final demand	Change in total output		Change in total employment[a]		Change in total household income[b]	
	thousand dollars	thousand dollars	percent	man-years	percent	thousand dollars	percent
Change in final demand[c]							
Agriculture and food processing (Sectors 1 and 2)	2,641 (2,641)[d]	4,141 (5,399)	4.9 (6.4)	320 (381)	5.85 (6.53)	1,354 (1,882)	3.40 (4.7)
Nonagriculture: manufacturing, non-manufacturing, and wholesale and retail (Sectors 3-5)	3,523 (1,180)	4,273 (2,215)	5.1 (2.6)	227 (121)	4.15 (2.01)	1,232 (911)	3.09 (2.3)
All sectors (1-5)	6,164 (3,821)	8,414 (7,615)	10.0 (9.0)	547 (502)	10.00 (9.18)	2,586 (2,792)	6.49 (7.0)
Increase in export[e]							
Household (labor)	(858)	(798)	(0.9)	(45)	(0.82)	(1,193)	(2.99)

a/ Computed on the basis of the 1961 output/labor ratio.

b/ Household income is calculated indirectly in Model I and directly in Model II.

c/ Final demand in Model I includes local final consumption by household and exports (sales outside the County); in Model II, only exports are included.

d/ Figures in parentheses relate to Model II.

e/ A hypothetical case illustrating the effects on the local economy of increases in population with no corresponding increases in local employment opportunities.

comparisons of absolute changes in final demand, interdependence coefficients alone may be used.

In Model I, a 10 percent change in final demand for the products of agriculture and food processing is estimated to increase the gross regional output by about 4.9 percent, or by $4.14 million; the corresponding effect on personal (household) income is 3.4 percent, or about $1.35 million. The corresponding change in employment, assuming 1961 output/labor ratios, is about 5.85 percent, or 320 man-years. This figure may be smaller if an increase in labor productivity actually occurs simultaneously with a change in final demand. A 10 percent change in final demand for the products of nonagriculture would increase total regional output by about 5 percent, or $4.27 million, and would increase household income by about 3 percent, or $1.23 million. Employment would increase about 4.15 percent, or 227 man-years.

While Model I essentially shows the impact of production-based interactions, Model II also reflects the impact of local consumption on expenditure of household incomes. A 10 percent change in the final demand for products of agriculture and food processing results in a higher change in the total County output ($5.4 million) in Model II than in Model I ($4.1 million). These results are comparable since final demand has no local consumption component for these sectors (see Table 1). The consequences of a 10 percent change in the final demand for products of the nonagriculture sectors are not comparable in Models I and II since there is a significant local consumption component for these sectors. However, the impact indicated in Model II is smaller than in Model I. The increase in total output of the County in agriculture and food processing is almost two and one-half times greater than that produced in the nonagriculture sectors. If the absolute change in final demand were the same for nonagriculture in Model II as in Model I ($3.5 million), the impact would be greater and would more nearly equal that of agriculture and food processing because of the induced effects of household.

An increase of approximately 10 percent in the export of household labor is given in Table 15 as a hypothetical example of a "bedroom problem," in which a local "bedroom" community is faced with an increase in population (i.e., increased personal income) with no corresponding direct increase in local employment and related tax base. Residents of a bedroom county, for example, work outside the county but consume public services within the county. The effect of such a situation on the local economy is generally indirect and

is usually reflected in increased business in the nonmanufacturing and wholesaling and retailing sectors. Thus, a 10 percent increase in the export of labor would bring $858,000 of new income into the County. At the state level of income per capita (roughly $2,700), this represents about 320 people; and, at the County ratio of population to employment (2.89:1), this means about 110 persons would be employed outside the County while living and spending inside the County.

Output Multipliers: Comparison of San Benito County (Model I) and California

Interdependence coefficients serve another useful function in an interindustry analysis. When summed for each producing sector (see Table 4), they may be used as multipliers to explain the changes in gross domestic output associated with unit changes in the final demand for products of each sector. Multipliers for California and for San Benito County (Model I) are shown in Table 16.[1/]

The output multipliers for the County indicate that a dollar change in the final demand for agriculture would require both directly and indirectly $1.52 of gross output; that is, the internal flows within the five producing sectors account for about 52 cents of gross output. Only the food processing sector has a higher output multiplier--$1.62. Manufacturing ranks third with a multiplier of $1.42, followed by nonmanufacturing, including business services, which ranks fourth with $1.39. The wholesale and retail sector is last with a multiplier of $1.06.

As expected, the multipliers for agriculture and food processing are higher than those for the remaining sectors. Nonmanufacturing has a large direct household (labor) input which is not included in Model I. The wholesale and retail sector has a large import coefficient, and its effect would be felt on higher imports rather than higher local outputs.

The Model I output multipliers for San Benito County and California compare favorably, except that the output multiplier for manufacturing (1.5757) is somewhat higher for California than it is for San Benito County (1.4239). This may be explained by the reversal of importance of agriculture and food

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1/ The multipliers for California are based on the study by Martin and Carter, op. cit., which is more like our Model I than our Model II.

TABLE 16

Output Multipliers for San Benito County (Model I) and California[a/]

Producing sectors	San Benito County[b/]		California[c/]	
	Multiplier	Rank	Multiplier	Rank
	1	2	3	4
1. Agriculture	1.5241	2	1.5353	3
2. Food processing	1.6195	1	1.9096	1
3. Manufacturing	1.4239	3	1.5757	2
4. Nonmanufacturing, including business services	1.3889	4	1.3926	4
5. Wholesale and retail	1.0581	5	1.3226	5

a/ Multipliers denote the total change in the gross output of the region associated with a change of $1.00 of output delivered to final demand by the corresponding producing sector.

b/ Multipliers are calculated as the sum of the interdependence coefficients for each sector (see Table 4).

c/ Multipliers are calculated as a weighted average of the individual figures given in William E. Martin and Harold O. Carter, A California Interindustry Analysis Emphasizing Agriculture. Part I: The Input-Output Models and Results and Part II: Statistical Supplement, University of California, Giannini Foundation Research Report No. 250 (Berkeley, 1962), 79p. and 121p., respectively.

versus nonagricultural industry in the two regions and by the fact that input requirements for manufacturing cannot be met locally in San Benito County to the degree that is true of the state as a whole.[1/]

Output Multipliers: Comparison of Models I and II, San Benito County

Output multipliers for San Benito County Models I and II are presented in Table 17. Output multipliers in Model II are substantially higher (2.3 to 2.9) than in Model I (1.39 to 1.62) for the agriculture, food processing, manufacturing, and nonmanufacturing sectors, mainly because of the large household (labor) input into these industries. The effects on the wholesale and retail sector (1.06 in Model I; 1.33 in Model II) are not as great.

The output multiplier for the household sector is about 2.32. This would indicate that an increase of $1 million in the local economy's net household income (accomplished through the export of labor including government jobs, the only means possible under Model II) would be accompanied by a household output of about $1.39 million (of which $0.39 million would be internally generated income) and an output of about $0.93 million by the other five producing sectors (see also Table 12).

The induced effects of including household as an endogenous sector in Model II are high in each sector, from $0.5 million to $0.6 million, except for the wholesale and retail sector ($0.11 million). These are also given in Table 17. It should be emphasized that Model II simply works out the effects of household expenditures, assuming that household income and expenditure patterns are those that occurred in 1961. Any other assumption would require the use of Model I.

EFFECTS OF ECONOMIC GROWTH AND ITS IMPACT ON THE SAN BENITO COUNTY ECONOMIC STRUCTURE

Any study of economic growth involves a good deal of judgment in the use of available data. The problem of "looking ahead" is beset with numerous obstacles; only some can be treated as given and constant. Existing

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1/ See pages 52-55.

TABLE 17

Comparison of Output Multipliers, Models I and II
San Benito County, 1961

Producing sectors	Model I	Model II			
	Output multipliers	Output multipliers	Household contribution	Output multiplier excluding household	Induced effect due to including household[a/]
	1	2	3	4	5
1. Agriculture	1.5241	2.8359	0.7861	2.0498	0.5257
2. Food processing	1.6195	2.6617	0.6246	2.0371	0.4177
3. Manufacturing	1.4239	2.8150	0.8336	1.9814	0.5575
4. Nonmanufacturing, including business services	1.3889	2.9133	0.9135	1.9998	0.6109
5. Wholesale and retail	1.0581	1.3328	0.1646	1.1682	0.1101
6. Household (labor)	[b/]	2.3212	1.3910	0.9302	[b/]

a/ This column represents the indirect effect in the multipliers due to including household as an endogenous sector in Model II.

b/ Household was not included as an endogenous sector in Model I.

Sources:

Cols. 1 and 2: Table 4, total interdependence coefficients.

Col. 3: Table 4, row 6, columns 1-6.

Col. 4: Column 2 minus column 3.

Col. 5: Column 4 minus column 1.

relationships among economic sectors provide a starting point for answering questions of the "what would happen if . . ." type.

A study of the effects of economic growth may be based upon projections of either total employment, output, or income of the region. In some cases, total personal income has been adopted for basic projections of growth in demand for products and services produced in the region.[1/] Another approach is to start with employment forecasts, industry by industry, as the basis for evaluating economic growth.[2/] The choice, however, may ultimately be determined by the availability of comparable data for the period under study.

In the present study, a survey of available time-series data disclosed that no continuous and comparable data on either output or employment could be obtained. However, usable data on total personal income were available for the post-World War II years from 1947-1958 to 1960-61, and personal income was therefore selected as the crucial variable for projection purposes. This choice was subject to the assumption of future stability in the economy, with no serious depression or large-scale war. The development of personal income projections is discussed in Appendix C.

The projections of total personal income were utilized in developing alternate final demand projections under different sets of assumptions as to future growth patterns.[3/] These projections were then utilized in conjunction with the input-output models to arrive at alternative impacts on the regional economy in 1975. It is not intended to predict what will in fact occur in 1975 but merely to point out the magnitude of the projection. In other words, the projections indicate what may happen if interindustry relationships keep their present form, after which it is possible to evaluate the effects of other changes, such as increases in labor efficiency.

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1/ For studies on economic growth projections using income as the important variable, see Irving J. Hoch, Forecasting Economic Activity for the Chicago Region: Final Report ("Chicago Area Transportation Study: Economic Activity Forecast"; Chicago: Chicago Area Transportation Study, 1959), 116p.

2/ For using employment as the common denominator for the purposes of projection of growth, see Arthur D. Little, Inc., Future Economic Growth in the West and Prospects for Rail Freight, A Report to the Atchison, Topeka & Santa Fe Railway Co., C-63918 (Cambridge, Massachusetts: Arthur D. Little, Inc., July, 1961), 278p.

3/ Rao, op. cit., Chap. V.

Analysis of Impact of Alternate Projections of Final Demand on the Growth of San Benito County Economy, Models I and II

Model I (Excluding Induced Effects of Household)

The analysis centers around selecting different final demand vectors, that is, changes in household income and exports that reflect changes in relative demand for agricultural and nonagricultural output and changes in the bedroom phenomenon.

Final demand in Model I consists of two components--local consumption expenditure, or simply local demand, and export demand, or the quantity sold outside the County.[1/] Separate estimates of local and export demand are made corresponding to total personal income within the County and in California by assuming that:

1. Local demand is influenced primarily by the rate of growth in personal income in the County. The effects of different income elasticities are ignored because most of the demand increases will be felt in the service industries, and direct final consumption from agriculture and food processing is negligible.

2. Export demand is influenced primarily by the rate of growth in personal income in California.[2/] The effects due to different income elasticities are thus taken into account in a somewhat approximate manner.

On the basis of these two broad assumptions, it is possible to state that local demand is growing at the rate of 2.7 percent, the County personal income growth rate; while export demand may be growing at the rate of about 5.5 percent, the growth rate in California's total personal income.[3/] However, these general assumptions may be questionable. The demand projections, for example,

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1/ The word demand is used here to mean quantity demanded over time in the aggregative sense. It is not to be confused with the economist's traditional concept of demand, meaning price-quantity relationships at one particular point in time.

2/ Strictly speaking, the export demand for products produced in San Benito County is influenced by a variety of factors such as growth in California economy, growth in the nation in general, and, to a lesser extent, dealings with the Common Market countries. In the absence of detailed statistics of exports and because of the uncertain nature of the issues involved, export demand for products and services produced in San Benito County is considered to be primarily influenced by the growth of personal income in California.

3/ See Appendix C for growth rates.

may not adequately cover different combinations of effects on local and export demand; that is, the differential effects due to population growth as opposed to changes in per capita real income may be substantial, and growth in demand for agricultural and nonagricultural output may not always be the same.

In order to take into account these differences and to recognize the growth or its absence in the relative share of San Benito County in California's total personal income, six different sets of assumptions were considered.[1/] Following is a summary of these alternate assumptions as they relate to the rate of growth in the Model I final demand sectors for goods and services produced in San Benito County:

Assumption set	Local demand	Export demand	
		Agriculture and food	Others
	percent		
I	2.7	5.5	5.5
II	2.7	3.0	5.5
III	2.7	3.0	3.0
IV	5.5	5.5	5.5
V	5.5	3.0	5.5
VI	5.5	3.0	3.0

1/ Rao, op. cit.

The six sets of assumptions may be interpreted as follows:

Assumption set	Local demand or local sales of products and services (consisting mainly of service industries; that is, Sectors 4 and 5) within the County.	Export demand or sales outside the County of products and services produced within the County (consisting mainly of products of agriculture including food processing and nonagriculture or manufacturing; that is, Sectors 1, 2, and 3).
I	Present annual rate of growth in the County's personal income, based on data for the years 1947-1961.	Continued full participation of the local economy in its sales outside the County, both agriculture and nonagriculture.
II	Same as above.	Partial participation of the local economy in that sales of agriculture, including food processing sectors, increase less than proportionately compared to changes in income.
III	Same as above.	Minimum participation of the local economy under the severe restriction that sales of both agriculture, including food processing, and nonagriculture increase only modestly.
IV	High annual rate of growth in local sales due to increases in demand for nonmanufacturing and wholesale and retail sales.	Same as in Assumption Set I.
V	Same as above.	Same as in Assumption Set II.
VI	Same as above.	Same as in Assumption Set III.

Assumption Sets I, II, and III suggest, through the 2.7 percent growth rate, that the present rate of change in local demand will be maintained, but the County will continue to decrease its share of total California personal income. The share of personal income of San Benito County in the California personal income has continuously decreased from 13:1,000 in 1947-1949 to about 9:1,000 in 1961. This ratio may further decrease to about 8:1,000 in 1965, 7:1,000 in 1970, and 6:1,000 in 1975 if past rates continue. Sets II and III reflect the typical reduction of the share of agriculture in the general economy that has been observed nationally. Set III is perhaps the closest to a projection of past trends, with no sector increasing very fast.

Assumption Sets IV, V, and VI use a high rate of growth in personal income, 5.5 percent, the result of an influx of population. Sets V and VI imply population pressures in the absence of corresponding industrial growth and are typical of the bedroom community situation in which many of the persons living in a community are employed beyond its boundaries. Assumption Set VI is the most extreme, with local demand increasing at the maximum rate, while both components of the export demand increase at the minimum rate. Set V contains an expanding nonagricultural sector, and Set IV represents equal rates of growth in all sectors.

Through the export of labor, it is possible that the County may maintain its share of personal income in the state, but its economic structure would nevertheless be altered (1) by the effects of housing developments on present agricultural land and (2) by the lack of new industrial activity, which would drastically limit the potential for increased employment, tax base, or other forms of economic growth.

On the basis of the above sets of assumptions, separate estimates of local and export demand for the products and services produced in San Benito County were projected. The two components of final demand were aggregated to form a total final demand for each set of assumptions. For each set of assumptions, the corresponding impact on the local economy's output, income, and employment was computed.

These projections are presented in Appendix E and their impact on output, employment, and income in the County given in detail. A summary appears in Table 18 which highlights the difference in impact of projected changes between agriculture and nonagriculture in the County. Agriculture and the food processing industry are grouped together; similarly, the group, nonagriculture,

TABLE 18

Impact on the San Benito County Economy, Model I--Different Sets of Assumptions on Growth, 1961-1975[a]

Assumption set	Output[b]			Employment[c]			Income[b]		
	Agriculture and food processing	Nonagriculture	Total endogenous sectors	Agriculture and food processing	Nonagriculture	Total endogenous sectors	Agriculture and food processing	Nonagriculture	Total endogenous sectors
	1	2	3	4	5	6	7	8	9
	thousand dollars			man-years			thousand dollars		
I	76,973[d] (123.1)	91,178 (83.8)	168,151 (100.0)	3,722 (31.9)	4,199 (58.8)	7,921 (44.9)	25,575 (123.0)	27,894 (94.0)	53,469 (106.9)
II	53,684 (55.6)	86,322 (74.0)	140,006 (66.4)	2,630 (-6.8)	3,973 (50.2)	6,603 (20.8)	17,844 (55.6)	26,429 (83.8)	44,273 (71.3)
III	53,668 (55.5)	75,406 (52.0)	129,074 (53.4)	2,629 (-6.8)	3,379 (27.8)	6,008 (9.9)	17,837 (55.5)	21,984 (52.9)	39,821 (54.1)
IV	77,143 (123.6)	110,936 (123.6)	188,079 (123.6)	3,779 (33.9)	4,953 (87.3)	8,732 (59.7)	25,641 (123.6)	32,145 (123.6)	57,786 (123.6)
V	53,853 (56.1)	106,079 (113.8)	159,932 (90.1)	2,640 (-6.4)	4,728 (78.8)	7,368 (34.8)	17,910 (56.2)	30,679 (113.4)	48,589 (88.0)
VI	53,838 (56.0)	95,164 (91.8)	149,002 (77.1)	2,639 (-6.5)	4,134 (56.3)	6,773 (23.9)	17,903 (56.1)	26,234 (82.5)	44,137 (70.8)

a/ This table is constructed on the basis of individual projections calculated for each sector (see Appendix E).

b/ Output and income are expressed in constant dollars (1961).

c/ Employment is given in man-year equivalent and does not represent the number of persons employed, which could be greater. The impact on population of any export of labor is not indicated.

d/ Figures in parentheses show indicated increases or decreases from the corresponding 1961 values.

as before, refers to the three remaining endogenous sectors--manufacturing, nonmanufacturing, including business services, and wholesale and retail.

While this agriculture-nonagriculture comparison is of considerable current interest, it is not the only comparison to which these projections lend themselves. Manufacturing, for example, could be singled out and compared with the other sectors if evaluation of the results of expanding existing manufacturing firms were of primary interest. The approach taken in the present comparison is to inquire into the impact of different combinations of accelerated expansion of the final demand sectors. For example, compared with Assumption Set III, which is a projection at present rates of growth, what is the effect on output, employment, and income of the alternative projections? A comparison of Set III projections with its corresponding 1961 values provides a forecast of the County's economy if present trends continue.

The projections of Set IV, with its high growth rates, versus Set III, with its moderate growth rates, would bring an additional $23.5 million to agriculture and food processing, $35.5 million to nonagriculture, and a total of $59 million to all sectors. This is the most optimistic projection employed, and the rapid expansion of local demand could occur with very little incidence of the bedroom phenomenon.

The failure of local demand to expand at the high rate in Sets I, II, and III, when compared with Sets IV, V, and VI, indicates a loss to total output volume of about $20 million in the projected year. This is almost entirely reflected in the difference in the output of the nonagricultural sectors. Agriculture and food processing output remains at about $77 million and $54 million, depending upon their assumed rate of growth, regardless of what happens to local demand or other exports.

The difference between $77 million and $54 million, or $23 million, is the output foregone directly if agriculture fails to grow at the accelerated rate. But the overall and indirect impact is indicated by a comparison of Set I with Set II and Set IV with Set V. In both the low and the high local demand cases, the failure of agriculture and food processing to expand at the higher rate results in a lower nonagricultural output of about $5 million and a decrease of $28 million in total output of all sectors.

When local demand is the only source of higher growth, as in Set VI, almost $20 million is added to total output. The expansion of nonagricultural exports alone at the higher rate of Set II versus Set III adds only $10.93

million, almost all in nonagriculture. But if agriculture and food processing also expand at the high rate, Set I versus Set III, $39.08 million is added to the total and $15.77 million of it in nonagriculture. Thus, if only agriculture and food processing expanded at the higher rate, some $28 million would be added to the Set III level of total output ($39.08 million less $10.93 million) and about $5 million to nonagricultural sectors ($15.77 million less $10.93 million). This illustrates the additive nature of these manipulations.

Employment results differ from changes in the output pattern due to the differences in the productivity growth rates assumed for each sector (again, see Appendix E). The largest increases in productivity of labor have occurred in agriculture and food processing, and this is expected to continue. In fact, when the assumed productivity rates of 3.9 and 2.9 percent, respectively, are combined, they exceed the low rate of output expansion assumed in Sets II, III, V, and VI. These then fit the decline in agricultural employment which has been the national trend for some years.

A comparison of Set VI with Set III again indicates the effect of local demand as the only source of growth; a total of 765 man-years of work are added from this growth alone. When Set II with only nonfarm exports growing faster is compared with Set III, 595 man-years are added, all in nonagriculture sectors. This difference is not as great as that found in the output comparison of $19.98 million and $10.95 million.

If both export demand sectors expand at the higher rate while local demand does not (Set I versus Set III), as many as 1,913 jobs are added--1,093 in agriculture and food processing and 820 in nonagriculture. Thus, if agriculture and food processing alone were to expand at the higher rate, the effect would be 1,318 jobs added overall (1,913 less 595), with 225 of these in nonagriculture (820 less 595). The result of the greater increases in agricultural productivity means that the ratio of new jobs in agriculture to the induced new jobs in nonagriculture (1,093:225 or 4.86:1) is similar to the ratio for output ($23.31 million:$4.84 million or 4.82:1).

The Set IV versus Set III comparison, with high versus moderate growth rates for all sectors, shows a 1,150 man-year increase in employment in agriculture and food processing, 1,574 in nonagriculture, and 2,724 overall. Instead of nonagriculture being 56.8 percent of the increase over the extension of present trends as in the case of output, it is 57.8

percent. It would appear that in intersector comparisons the net effect of the higher productivity rate is slight.

As for personal income, growth due to greater acceleration of local demand, Set VI versus Set III, produces a difference of $4.32 million, almost all in the nonagriculture sectors. Accelerated nonagricultural exports alone, Set II versus Set III, produces $4.45 million, also largely in the nonagricultural sectors. The difference between this and the output comparison is even more striking than in the case of employment; it reflects the differing importance of household (labor) as an input into the productive processes of each sector.

When both the export components are accelerated, as in Set I, the increase over Set III is $13.65 million in total personal income, $5.91 million of which is added to the nonagricultural sectors. Thus, if agriculture and food processing were to accelerate alone, the total effect on income would be $9.20 million ($13.65 million less $4.45 million); and this would produce $1.46 million in income ($5.91 million less $4.45 million) for the nonagricultural sectors.

As with employment, the accelerated rate of expansion of agriculture and food processing produces an impact on nonagriculture which is not quite the same as that indicated for output. Additional agricultural and food processing output rose roughly $4.82 for each dollar of induced output in the nonagricultural sectors. For employment the ratio was similar, about 4.86 man-years to 1, but for income it is $7.74 million in new income in agriculture to $1.46 million in nonagriculture or $5.30:$1.00. In other words, output, employment, and income give slightly different results in an evaluation of the interest of the nonfarm sectors in an expansion of the farm sectors.

With acceleration in all sectors, as in Set IV versus Set III, an income increase of $7.80 million occurs in agriculture and food processing, $10.16 million in nonagriculture, and $17.96 million overall. Nonagriculture is about the same proportion of the increase at 56.6 percent, as in the case of output, as might be expected since the relation of income to output is kept constant in this projection.

It would be possible now, with the use of the employment and income figures, to compute a change in return per man-year which should indicate a less rapid increase in the nonagricultural sectors than in the others. The suggestion of a possible manipulation of this kind should suggest at once to the

reader that the projections described above can at best give only general indications of possible changes. Many factors have not been taken into consideration, such as an increased overproduction of farm products nationally, which could lead to further farm price declines and corresponding effects on output and income in the agricultural sector.

With employment projections, it is possible to construct partial population projections, such as those shown in Table 19 for San Benito County. These are only partial projections because they fail to indicate the influence of the bedroom phenomenon upon projected local demand. In other words, the population estimates are based only on internal employment, with the assumption that the employed and their dependents reside within the County and that the ratio of employed to jobs is unchanged from 1961.

If the proportion of personal income spent locally for consumption (local demand) remains constant, personal income would be expected to expand at the same rate of growth that has been assumed for local demand. Projections of personal income at 2.7 and 5.5 percent are also shown in Table 19. For Assumption Set IV the projection is very close to the level of personal income generated in the system, but for Sets I, II, and III the internally generated personal income exceeds that of the projection. This would seem to imply three alternative conditions: (1) an increase in consumption expenditures made outside the area, savings, etc.; (2) the import of some labor (some other area serving as the bedroom); or (3) higher local consumption expenditures than those indicated in the relationships of Model I. Sets V and VI show the reverse conditions. In other words, the population projections for Set IV, and very nearly for Set III, indicate a bedroom phenomenon proportional to any now existing, assuming consumption expenditures of the present pattern. But the differences between I or II and III roughly show the possible extent to which population living elsewhere could be supported by jobs in San Benito County. Conversely, the differences between V or VI and IV indicate the extent to which the export of labor would be required to boost personal income enough to meet the assumed rate of growth in local demand.

Model II (Including Induced Effects of Household)

The elaborate development of assumption sets for Model II produces results that are largely redundant. Assumption Sets II-a and V-a focus on the

TABLE 19

Summary of Alternate Projections, Model I--Population, Employment and Total Personal Income, San Benito County, 1975

Assumption set	Population[a]	Employment in endogenous sectors[b]	Total personal income	
			In 1961 constant dollars[c]	Direct projection in 1961 constant dollars[d]
	1	2	3	4
	number	man-years	thousand dollars	
I	22,892	7,921	82,445	59,315
II	19,083	6,603	68,265	59,315
III	17,363	6,008	61,401	59,315
IV	25,236	8,732	89,101	89,170
V	21,294	7,368	74,920	89,170
VI	19,574	6,773	68,056	89,170

a/ Population projections were based on the constant ratio between man-year employment and population during the year 1961 (5,467:15,800). See Table 21 and text for the effect on population of changes in the number of families whose income is earned outside the County.

b/ Employment was adjusted for increases in productivity of labor.

c/ Total personal income was calculated on the basis of the 1961 ratio between the household income of the five endogenous sectors and total personal income (25,847:39,854). This includes income from the export of labor and is not strictly comparable to data in column 1.

d/ Total personal income was calculated on the basis of assumed alternate growth rates 2.7 and 5.5 percent.

effect of different rates in the export of labor, or the bedroom phenomenon. The rates of growth used are:

Assumption set	Export demand		
	Household (labor)	Agriculture and food	Other
	percent		
II-a	3.0	3.0	5.5
V-a	5.5	3.0	5.5

While in Model I it was necessary to specify a growth rate for local demand, local consumption expenditure is determined endogenously in Model II. But now a specific rate of increase in the export of labor may be used in a projection. Thus, Assumption Sets II-a and V-a are analogous to II and V, but the results are not strictly comparable because the projected expansions in final demand are not the same. They could have been made more comparable if the export or import of labor were made equal to the amount required to produce the projected expansion in local demand.1/

In Table 20, the results of a modest increase in the export of labor is compared with a high rate of bedroom growth, and the effect on agriculture and food processing appears to be negligible. The difference in output amounts to only $46,000. However, this does not reflect any adjustments for land use interaction. As shown in Table 21, these two levels of labor export produce a difference in household income of $5.83 million which represents an export of 593 more workers, all of whom would need new homes. At three to five homes per acre, about 120 to 200 acres of land would be required to provide these homes. Were these to be located on agricultural land producing $230 or more per acre (moderately intensive use, such as orchard or vegetable crops), the

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1/ To correspond more closely to Model I, Set V, about a 9 percent instead of a 5.5 percent rate of increase in the export of labor in Model II, Set V-a, would be required. This would produce internally the $89.17 million of personal income which can be implied by the 5.5 percent rate of local demand expansion in Model I, Set V. The value of the labor export would be $28.5 million instead of $19.175 million.

TABLE 20

Impact on the San Benito County Economy, Model II--Different Sets of Assumptions on Growth, 1961-1975[a]

Assumption set	Output[b]				Employment[c]			
	Agriculture and food processing	Nonagriculture	Household	Total endogenous sectors	Agriculture and food processing	Nonagriculture	Household	Total endogenous sectors
	1	2	3	4	5	6	7	8
	thousand dollars				man-years			
II-a	53,735[d] (55.7)	92,219 (85.9)	68,197 (71.1)	214,151 (72.7)	2,633 (-6.7)	3,445 (30.2)	677 (35.4)	6,755 (13.2)
V-a	53,781 (55.9)	97,598 (96.7)	76,308 (91.5)	227,687 (83.6)	2,635 (-6.6)	3,620 (36.9)	756 (51.2)	7,011 (17.5)

a/ This table is constructed on the basis of the individual projections calculated for each endogenous sector, Model II (see Appendix E).

b/ Expressed in constant 1961 dollars.

c/ Employment is the man-year equivalent and does not represent the number of persons employed.

d/ Figures in parentheses show percentage changes from the corresponding 1961 values.

TABLE 21

Additional Effect on Population Due to Export of Labor
Model II, San Benito County, 1975

Assumption set	Initial increase in household income due to export of labor[a]	Effect on population and number of persons employed outside the County			
		Using 1961 average per capita income for California ($2,719)		Using 1975 average per capita income for California ($3,389)	
		Population[b]	Number of persons employed outside the County[c]	Population[b]	Number of persons employed outside the County[c]
	1	2	3	4	5
	thousand dollars				
II-a Increase in export of labor at 3 percent per year	4,767	1,753	606	1,407	489
V-a Increase in export of labor at 5.5 percent per year	10,598	3,898	1,349	3,127	1,082

a/ Obtained as a difference between projected figure for 1975 and the corresponding figure for 1961.

b/ Population effect is obtained by dividing the figure in column 1 by the corresponding average per capita income.

c/ Employment effect is obtained by using the ratio of population to employment, 2.89:1 (observed in San Benito County).

stimulation to agricultural output could be completely offset. This example serves to emphasize again the point that projections such as these furnish only partial information and must be supplemented for almost any practical application.

While a high rate of bedroom growth may have a minor effect on agriculture, its effect on nonagriculture is substantial. The difference in output is $5.379 million (see Table 20), and a difference in employment in the nonagriculture sectors (excluding household) is 175 man-equivalents. Within the household sector itself, there is a significant effect. While the amount of household income attributable to labor exports is $5.83 million, the difference in total household income (output) is $8.11 million. There is also an expansion of employment within the household sector itself (domestics, medical services, etc.) of 79 man-equivalents.

Employment and partial population projections for Model II are similar to those for the analogous assumption sets in Model I (see Table 22). The expansion of local demand by $11.434 million in Model I, Set II, has about the same effect on internal employment and related population as an increase in the export of labor of $4.767 million in Model II, Set II-a. Part of this result is due to the higher multiplier effects built into Model II, since consumption expenditures work themselves out fully. In Sets V and V-a, the expansion of local demand in Model I amounted to $28.953 million, while the export of labor rose by $10.598 million in Model II.

In Model II the comparison of the direct projection of personal income with that generated endogenously is less significant than in Model I (see Table 22). In Model I a similarity in rates could be conjectured between domestic demand and personal income, but in Model II the export of labor and the increase in personal income need not occur at exactly the same rate even though they are related through the multiplier effects. As mentioned earlier, the difference between $68.265 million generated personal imcome in Model I, Set II, and its projected income of $59.315 million could be explained by a possible import of labor or other factors. The $68.197 million generated personal income of Set II-a, Model II, includes the direct and indirect effects of the assumed export of labor and simply indicates a rate of growth in excess of the 2.7 percent used to compute the $59.315 million projection.

TABLE 22

Comparison of Models I and II, Summary of Alternate Projections
Population, Employment, and Total Personal Income
San Benito County, 1975

Assumption set and model	Population[a]	Employment in endogenous sectors[b]	Total personal income	
			In 1961 constant dollars[c]	Direct projection in 1961 constant dollars[d]
	1	2	3	4
	number	man-years	thousand dollars	
II-a				
Model I	19,083	6,603	68,265	59,315
Model II	19,522	6,755	68,197	59,315
V-a				
Model I	21,294	7,368	74,920	89,170
Model II	20,262	7,011	76,308	89,170

a/ Population projections were based on the constant ratio between man-year employment and population during the year 1961 (5,467:15,800). See Table 21 and text for the effect on population of changes in the number of families whose income is earned outside the County.

b/ Employment was adjusted for increases in productivity of labor.

c/ Total personal income was calculated on the basis of the 1961 ratio between the household income of the five endogenous sectors and total personal income (25,847:39,854). This includes income from the export of labor and thus is not strictly comparable to data in column 1.

d/ Total personal income was calculated on the basis of assumed alternate growth rates, 2.7 percent and 5.5 percent.

SUMMARY AND CONCLUSIONS

This paper has reported the empirical results, and the underlying theoretical models of interindustry analysis applied to the economy of San Benito County. Essentially, it studied alternate input-output models to explain the County's economy and to compare it with the structure of California economy. The input-output models were then utilized to study the impact of alternate patterns of economic growth upon the structure of the San Benito County economy.

An economic survey made of commercial and industrial establishments in San Benito County revealed that the processed food and manufactured products produced in the County were largely exported outside the County, and a bulk of the products and services of the nonmanufacturing and trade sectors were sold within the County. The information on expenditure flows collected in the survey, with some modifications, was utilized to form the input-output models. Retail and wholesale transactions, as all others, were used at full value rather than value added. An important feature of the input-output model formation was its treatment of the household sector as an exogenous sector in Model I and as an endogenous sector in Model II. By this means, Model II represents a full expenditure model and its results are believed to correspond more closely to what businessmen and other local decision makers visualize.

The interindustry flow of goods and services within and outside the County presented in Table 1 formed the basic data for deriving the input-output results of the two models.

The interdependence coefficients of Models I and II are given in Table 4. For the agriculture, food processing, and manufacturing sectors, these coefficients are very similar in both the models; but for the nonmanufacturing, including business services, and wholesale and retail sectors, Model 1 gives lower coefficients than Model II. This was not unexpected since household was included as an endogenous sector in Model II.

A comparison of technical and interdependence coefficients of Models I and II (Tables 9-14) revealed the importance of the indirect effect on each other sector in the economy corresponding to given changes in the final demand for the products and services produced in the County. This kind of effect is not immediately evident in the interindustry flow of goods and services (Table 1).

The induced effects of including the household sector as an endogenous sector in Model II were nearly $0.5 million to $0.6 million per million dollars of export in each of the sectors except wholesale and retail. These induced effects were due to the evaluation of second and subsequent round effects of changes in household income on the County's economy which were not recognized in Model I.

A comparison of interdependence coefficients for agriculture (including food processing) and nonagriculture for San Benito County (Model I) revealed that a proportional change in final demand for products of agriculture induced a greater percentage change in output of nonagriculture than a similar change in final demand for nonagriculture induced in the output of agriculture. This result was in direct contrast to what occurred in the California economy (Tables 13 and 14).

An examination of the output multipliers for San Benito County (Model I) and California revealed that they compare favorably with one exception. The output multiplier for manufacturing (1.5757) for California was somewhat higher than that for San Benito County (1.4239), mainly because the input requirements for manufacturing cannot be met locally in San Benito County to the degree possible within the state as a whole (Table 16). Also, the relationship of agriculture and food processing with nonagriculture was reversed in the two regions. Agriculture and food processing accounted for nearly five times the output of manufacturing in San Benito County economy, whereas California's output of agriculture and food processing was less than half the output of manufacturing.

Multipliers corresponding to Model II for San Benito County are not available for the state. And these alter the rankings of the sector multipliers in the County (see Table 17). Agriculture and manufacturing kept their relative positions of second and third, but food processing moved from first to fourth, and the nonmanufacturing, including business services, sector moved from fourth to first. While Model I sector multipliers ranged from 1.3889 to 1.6195 for these sectors, those for Model II ranged from 2.6617 to 2.9133. Thus, the multipliers were 1.6 to 2.1 times larger in Model II. The wholesale and retail multiplier rose from 1.0581 in Model I to 1.3328 in Model II. The contribution of households to local expenditure multipler effects is substantial, representing over half of the change from Model I to Model II multipliers. The remainder is a reflection of the effect induced among sectors by including

households as endogenous. Model II also provides an estimate of the impact of exporting labor (the bedroom population phenomenon) in its multiplier for households of 2.3212.

The interdependence coefficients of Models I and II were used in evaluating the impact of economic growth on the local economy under six different sets of assumptions regarding growth.

Assumption Sets I, II, and III suggest, through a growth rate of 2.7 percent, that the present rate of change in local demand remains constant, but the County's share of total California personal income continues to decline as it has in the past from 13:1,000 in 1947-1949 to about 9:1,000 in 1961. Further decreases may occur--to about 8:1,000 in 1965, 7:1,000 in 1970, and 6:1,000 in 1975--if the past rates continue. Sets II and III reflect the typical reduction of the share of agriculture in the general economy observed nationally, with other portions of final demand expanding at either 3.0 or 5.5 percent while that for agriculture expanded at 3.0 percent. Set III is perhaps the closest to a projection of past trends, with no sector increasing very fast.

Assumption Sets IV, V, and VI use a high rate of growth in personal income, 5.5 percent, probably the result of an influx in population. Sets V and VI imply population pressures in the absence of corresponding industrial growth and are examples of the bedroom community situation in which much of the resident population of a region is employed outside it. Assumption Set VI represents the most extreme form in which local demand increases at the maximum rate, but both parts of the export demand increase at the minimum rate. Set V contains an expanding nonagricultural sector, and Set IV represents equal rates of growth in all sectors.

Details of the projections and their impact under the above sets of asasumptions are given in Appendix E and summarized in Tables 18 and 20. The end result of the analysis of Model I indicated that the population supported by employment in San Benito County may vary between 17,363 (Assumption Set III) to 25,236 (Assumption Set IV). The final analysis of Model II also indicated that population due to the export of labor could increase by another 1,400 to 3,900. This would account for both the induced effects of household expenditure on the local economy and for the export of labor.

The following comments on Model I versus Model II are in order. The purpose of this study has not been to establish the supremacy of one type of

model over the other but to investigate their relative usefulness in solving some of the relevant problems of given changes in certain variables, such as the export of labor, and to compare local coefficients with other similar coefficients.

Model I, the common form of analysis used for national and statewide studies, treats household as an exogenous sector; its use made possible the comparison of San Benito County and California coefficients in our study. Its use also enabled the authors to study the effects of given changes of certain exports of goods and services and to stipulate autonomous changes in household consumption expenditure in order to study their impact on the local economy's output and income. Though there is nothing wrong with the mechanics behind this method of approach, the impact on the local economy is underestimated in the sense that when there is an autonomous change in the export of labor, it may be unrealistic to think that the local household expenditure will remain constant because of the indirect generation of internal income of households.

Model II treats household as one of the endogenous sectors and has a definite advantage over Model I in its direct evaluation of changes due to household expenditures, a matter of particular concern to local officials and businessmen. Induced effects of the household sector are recognized in Model II, and correspondingly higher coefficients are obtained which reflect these effects. Similar results could be obtained in Model I only by the process of iteration.

Opposition to the use of Model II is usually based on the argument that the household sector is more likely to violate the assumption of constant technical coefficients than the other producing sectors. But this is probably less likely to be true for the small local economy with its high volume of imports in every sector than for the national economy which is more nearly self-sufficient. However, to the extent that it is true, Model II cannot be used as satisfactorily as Model I to project the structure and growth of the local economy into the more remote future.

The authors are of the opinion, however, that both models are more than moderately useful for solving specific problems and questions raised by local officials and businessmen, as illustrated by the specific use of the two models in different situations. Nevertheless, from a methodological point of view, considerable scope remains for further research in this area.

APPENDIX A

Survey of Commercial and Industrial Establishments, San Benito County, 1961 Tabulation Procedure and Assumptions

The various steps involved in the tabulation of survey results, as well as the assumptions made and their implications, are briefly discussed below.

Step 1

Each firm was given a code number and classified according to its respective economic sector, and the available data on sales and employment were tabulated. The employment data obtained in the survey were sufficient to develop man-month or man-year equivalents, but the total sales data and their distribution to individual economic sectors were sometimes incomplete. Employment estimates (man-year equivalents) provided a common basis for developing total sales in individual economic groups as a whole. To facilitate the use of total employment estimates in blowing up "survey totals" to correspond to "county totals" within each economic sector, it was assumed that total sales were proportional to total employment within each economic group.

It may be argued with some validity that this assumption may not be equally tenable for all economic groups because of possible differences among firms in economies of scale and in the ratios of production to nonproduction employment. However, in the nonmanufacturing, including business services, sector these differences are not significant since labor is so important an input in these industries. In the food processing and manufacturing industries, the limitation was found to be applicable to firms corresponding to an employment of about 490, or less than 8 percent of the County's total employment of 6,500. It may have been better perhaps in such cases to assume that sales are proportional to a certain portion of employment, depending upon the nature of production. But in the absence of adequate detailed information on

employment, the assumption of proportionality of sales to total employment within each economic group was considered to be not unreasonable.[1/]

Step 2

Firms in each economic sector were classified according to four categories:

1. Firms which supplied actual information on total sales, sales to various economic sectors, employment, etc.

2. Firms which supplied actual total sales, employment, etc., but only percentage information on sales to various economic groups.

3. Firms which supplied percentage information on sales to different economic groups, employment, etc., but gave no actual total sales.

4. Firms which failed to respond to the survey questionnaire but for which employment data were available from published sources.

Most of the firms for which the total sales had to be blown up to correspond to County totals were in the nonmanufacturing and service sectors and fell in category 4 above, while the firms in the food processing and manufacturing sectors fell within categories 1 to 3.

Step 3

For firms in category 1, total sales to each economic sector were obtained by a simple aggregation of the reported individual sales to each sector.

For firms in category 2, total sales to each economic sector were calculated by using the total sales and the individual percentage sales reported for each economic sector.

Total sales of firms in categories 1 and 2 were then aggregated to provide the basic data needed to estimate the sales of firms in categories 3 and 4.

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1/ Similar adjustments due to incompleteness of survey data are usually made in order to develop information corresponding to total employment in the region under study. See W. Lee Hansen, R. Thayne Robson, and Charles M. Tiebout, "State of California Economic Development," Agency Markets for California Products (Sacramento, 1961), p. 29.

Werner Z. Hirsch, "Interindustry Relations of a Metropolitan Area," The Review of Economics and Statistics, Vol. XLI, No. 4 (November, 1959), pp. 360-369, especially p. 361.

Step 4

Since total employment figures for firms in category 3 were known, total sales per person employed (developed in Step 3) were used to develop total sales of firms in category 3. Actual sales to different economic groups were then estimated on the basis of the individual percentages of sales reported.

Total sales for firms in category 4 were estimated on the basis of sales per person employed, as calculated earlier. Sales to the individual economic groups were then estimated on the assumption that these sales were distributed among the economic groups in the same pattern observed in the firms within categories 1 to 3.

Sales and employment data for the four categories were then aggregated to form the total sales and employment of firms for each economic sector.

This procedure was used for all economic sectors except "personal services." Data for this group were obtained from the U. S. Census of Business, 1958, and it was assumed that this group made all of its sales inside the County.

Step 5

The following additional assumptions were made:

1. Sales directly to consumers were assumed to represent final consumers' demand or "domestic final demand," and no attempt was made to provide an actual breakdown between sales inside and outside the County. This assumption was made because it was felt that the collection and tabulation of detailed sales data would be too time-consuming and difficult a task.

2. Sales to government, whether local, state, or federal, were all treated as exports, that is, as sales outside the County.

3. Sales to the various economic sectors within and outside the County other than final consumers and government were assumed to bear the same ratios as those obtained for the total distribution of sales.

Assumption 3, most important of the group, was necessitated by the lack of elaborate information on sales inside and outside the County. Detailed questions in this area were deliberately omitted from the survey questionnaire in the interest of brevity and simplicity of analysis. The following conditions were implicit in assumption 3: (1) most of the sales of the food processing and manufacturing industries are made outside the County and (2) sales of the nonmanufacturing, including business services (such as construction,

personal services, etc.) sector and the wholesale and retail sector are made within the County. The proportions of "inside" and "outside" sales of these industries found upon tabulation are as follows:

Industry	Sales inside the County	Sales outside the County	Total
	percent		
Food processing	0.18	99.82	100.00
Manufacturing	5.77	94.23	100.00
Nonmanufacturing	73.26	26.74	100.00
Construction	99.30	0.70	100.00
Finance, real estate, and insurance	90.00	10.00	100.00
Personal services	100.00[a/]	0	100.00
Wholesale and retail	93.00	7.00	100.00

a/ By assumption (see Step 4).

The effect of assumption 3 (of Step 4) in the food processing and construction industries appears to be negligible. Some resulting bias may be evident in the manufacturing sector, in the finance, real estate, and insurance subsector, and in the wholesale and retail sector. Assumption 3 may therefore have a strong effect only in the nonmanufacturing sector, for which the deviations of inside and outside total sales were appreciable--about 73 and 27 percent, respectively. But, since the nonmanufacturing sector accounts for only about 10 percent of the total sales in the County, this bias was not considered serious. All of the business service groups--nonmanufacturing; construction; finance, real estate, and insurance; and wholesale and retail--were finally aggregated into a single sector called nonmanufacturing, including business services.

APPENDIX B

Construction of the Input-Output Flow Table
Data Sources and Adjustments
by Economic Sectors

Sector 1--Agriculture

Data relating to the input structure of San Benito County agriculture was derived from the California interindustry study by Martin and Carter, thus eliminating the need for a time-consuming analysis of farm operations.[1/] Only the "input from manufacture" sector required modification in its application to this study. The California coefficient was clearly too large for San Benito County, since the sales to agriculture of its manufacturing firms were merely about 1 percent of the manufacturers' gross sales. Most of the inputs from manufacturing industries to agriculture in San Benito County come either from local wholesale and retail firms or are imported directly from sources outside the County. Consequently, it has been assumed that inputs from manufacture to agriculture were purchased through local wholesalers or retailers and included in the wholesale and retail sector, and corresponding adjustments have been made in the final demand component of that sector.

While the composition of agricultural output of San Benito County in 1960 was similar to that of California in 1954, it is nevertheless possible that the California coefficients may over- or underestimate the true coefficients for San Benito County.[2/] At least two limitations in the use of the California coefficients must therefore be taken into account. The first arose simply from the methodological problem of applying a California flow coefficient to

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1/ For all references to data sources and empirical studies, see the selected bibliography, p. 107.

2/ The composition of output of livestock and crops is about 1:2, both in San Benito County and California. This is based upon the San Benito County Agricultural Commissioner's reports and the Martin and Carter study, Part I, Table 1, p. 35.

San Benito County.[1/] As a result, inputs from local food processing to agriculture may be somewhat high, for to some extent these were imported from outside the County. No firm basis for alternative allocation was found, and it is believed that the discrepancy is not large enough to be crucial.

The second limitation exists because of differences in definition of output of the wholesale and retail sector. In the California study, "margins" were used rather than gross value of output handled by the trade sector. Consequently, it is possible that wholesale and retail inputs for San Benito County may have been underestimated. It should be observed here that had the inputs from the wholesale and retail sector been entirely imported, the error resulting from the use of margins would not be appreciable.[2/]

On the basis of the California technical coefficients, the input structure for San Benito County agriculture was calculated as follows:

Sector	California agriculture--inputs for producing a dollar of output	San Benito County agriculture--inputs based on 1961 output
	cents	thousand dollars
Agriculture	13.357503	2,831
Food processing	5.907598	1,252
Manufacturing	10.121577	2,145[a/]
Nonmanufacturing, including business services	3.022025	831[a/]
Wholesale and retail	5.620514	1,191[a/]

a/ The manufacturing input is reduced from $2,145,000 to $220,000, and a corresponding adjustment is made in the wholesale and retail trade.

1/ See the discussion of technical coefficients in the text, page 17.

In order to overcome this limitation, one could adopt a slightly different procedure in estimating the coefficients for San Benito County agriculture. For example, one could assume that the flow of inputs into San Benito County agriculture is similar to that in California agriculture; on this basis, the California coefficients could be used to allocate total output of San Benito County agriculture. This assumption was not made in the present study because (1) there was a large import coefficient--nearly 14 percent--for the California livestock sector and (2) the local input from manufacture to agriculture is much smaller for San Benito County than for California.

2/ Such an error could have been entirely eliminated by the use of identical definitions of the trade sectors and identical concepts of output in the two studies.

Sector 2--Food Processing

The input structure of the food processing sector is based in general on the sales figures obtained from the survey. As indicated, only the input from agriculture, about $3.8 million, has been estimated on the basis of the California economy. Furthermore, for the following reasons, it has been assumed that the entire amount came from within the County.

An external check (accomplished through the survey questionnaire described in the text) indicated that the total raw material requirement of the food processing industry came to about $5.2 million. Of this total, the inputs from manufacturing (tin cans, for example) amounted to about $1.4 million, and the inputs from agriculture (such as raw fruits and vegetables) were about $3.8 million. These findings were in agreement with the Martin and Carter agricultural input data. Since it had already been established that the manufacturing industry in San Benito County supplied very little to the food processing sector, the total input from manufacture of $1.4 million was presumed to have been imported from outside the region and was therefore included in the dummy sector, "unallocated inputs."

Following are the technical coefficients for the raw material inputs from agriculture and manufacturing into the food processing industry, calculated on the basis of the Martin and Carter study:

Sector	California technical coefficients--inputs for producing a dollar of output	San Benito County input structure
	cents	thousand dollars
Agriculture	0.283706	3,777
Manufacturing	0.108457	1,444
Total raw material	0.392163	5,221

Sector 3--Manufacturing

The input structure of the manufacturing sector of San Benito County is largely based on the sales figures obtained from the mail survey previously discussed. However, the input of about $5.934 million from the nonmanufacturing sector was considered much too high compared with the $1.975 million which was obtained through an external check. It was decided to use the latter figure.

Sector 4--Nonmanufacturing, Including Business Services

This sector consisted of mining, construction, finance, real estate, and selected services. Survey results were generally used for all of these subsectors except the last, which is composed of a large number of small establishments for which no information was collected. For this subsector, 1958 U. S. Census of Business data were used, adjusted for increases in total personal income between 1958 and 1961.

Inputs for the selected services subsector consisted mainly of other services not already specified and inputs from wholesale and retail. These were estimated as follows on the basis of data from the Hansen, Robson, and Tiebout study mentioned in the text.

	Percentage distribution	San Benito County (estimated)
		dollars
Input from other services	39.07	566,000
Input from wholesale and retail	13.91	202,000
Total output	100.00	1,449,000

These figures were added to the corresponding input figures for the other subsectors to obtain the total inputs for the nonmanufacturing, including business services, sector.

Sector 5--Wholesale and Retail

Information obtained from the survey was used, with some minor adjustments, to reflect sales of imported manufactured goods to the agricultural sector.

Sector 6--Household

Discussion of the household sector is divided into (1) its treatment as a consuming sector and (2) its development as a producing sector.

Household (Consumer).--This sector is the domestic component of final demand and represents local final consumption of goods and services produced

in San Benito County in 1961 and is equal to total personal income, $39.854 million. The input data for all sectors were obtained from the economic survey of the County and were used without change except in the nonmanufacturing, including business services, sector. The input of $5.367 million from this sector into household was slightly adjusted as follows:

Total sales per survey results			$5,315,000	
Less sales to agriculture			211,000	$5,104,000
Contribution of selected services, including hotels, motels, etc. (estimated)			1,449,000	
Less sales to:				
Agriculture	$620,000			
Nonmanufacturing, including business services	566,000	1,186,000	263,000	$5,367,000

The household (labor) input of $5,430 million into household (domestic final demand) represented household personal consumption expenditure on domestic service, medical expenses, legal fees, educational expenses, religious expenses, etc., all of which were not included in the selected services subsector of Sector 4. These items were equal to about 17 percent of total consumption expenditure on the basis of United States consumption figures for 1961.[1/]

The unallocated input figure into household was $10.993 million, a residual from the column total of $39.854 million consisting of personal federal income taxes, $4.954 million; personal savings, $2.479 million; and miscellaneous unallocated inputs of $3.560 million. Taxes represent the difference between total and disposable personal income, while the difference between disposable personal income and personal consumption expenditure constitutes personal savings. These were estimated on the basis of United States data for 1961, as follows:

	United States		San Benito County
	million dollars	percent	thousand dollars
Total personal income	416,700	100.00	39,854
Disposable personal income	364,900	87.57	34,900
Personal consumption expenditure	339,000	81.35	32,421

1/ U. S. Bureau of the Census, Statistical Abstract of the United States, 83rd ed., 1962, pp. 313-315.

Household (Labor).--It is known that the contribution of the household sector to agriculture consists of many types of paid and unpaid labor and managerial activities, but no satisfactory estimates of household contribution could be obtained from available data sources, chiefly for the following reasons:

1. Figures on total employment and wages were not available on a comparable basis.

2. Employment figures are not generally given in terms of man-month or man-year equivalents but usually only in terms of the number of persons employed on a certain reference date.

3. Unpaid family labor is usually omitted from total hired wages.

The household contribution to agriculture was, therefore, estimated on the basis of the 1961 schedule of wage rates in conjunction with the latest available midmonth 1961 employment estimates for different kinds of labor.[1/]

The household contribution to the food processing, manufacturing, and wholesale and retail sectors was calculated on the basis of the payroll and employment figures for the County given in the U. S. 1958 Censuses of Manufacturers and Business and adjusted for increases in household income and employment between 1958 and 1961.

Because detailed statistics on wages in the nonmanufacturing, including business services, sector are not available for the County, corresponding state figures were used, weighted in accordance with County employment figures.

The household input into local consumption includes expenditures on personal consumption, including domestic services, medical care, legal fees, religious expenses, and other personal services not included in the selected business services of Sector 4. These expenditures were estimated on the basis of corresponding United States figures for 1961.

The household input represented by employment in government and industry outside the County constitutes a residual and was allocated to "exports." The total output of the household row thus becomes the equivalent of personal income in San Benito County.

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1/ U. S. Statistical Reporting Service, Farm Labor, various issues.

California Department of Employment, California Farm Labor Report, 881-A, various issues.

U. S. Bureau of the Census, U. S. Census of Agriculture, 1959, Vol. I, 1963.

A brief explanation of the detailed calculations of the household inputs into the several economic sectors follows:

Agriculture: First, midmonth estimates of 1961 employment were collected by type of labor--farmers and unpaid families, hired domestic, and foreign contract.[1/] These are given in Table B.1.

Second, monthly estimates of total hired employment were converted to their full-time equivalents, and total hired wages were calculated at an average hourly wage rate of $1.25 (see Table B.2).

Third, a subjective estimation was made of operators' incomes. According to Table B.1, there were about 550 operators in San Benito County in 1961. In the same year the net average income of a farm operator in the state of California was slightly in excess of $8,000, a figure considered to be too high for San Benito County, where in some cases it has been as low as $4,000. A comparison of county and state figures with respect to total number of farms, relative number of commercial farms, and total and average value of agricultural products sold led to the conclusion that operators' incomes in San Benito County were undoubtedly lower than in California as a whole (see Table B.3). Furthermore, while the County has more large-size farms and fewer small-size farms relative to California, it has relatively fewer Class I commercial farms with $40,000 or more of gross sales of agricultural commodities than the state as a whole. In addition, only 17.4 percent of the County's farms are classified as Class I commercial farms compared with 21.7 percent so classified for California. But the most telling evidence of a lower level of operators' incomes in San Benito County is the difference in gross sales per farm, estimated to be only three-fourths of the state level, according to related studies.[2/] In the absence of any other satisfactory estimate, $6,000 was selected as the average net income of the farm operator in San Benito County and total operators' incomes were therefore calculated to be $3.300 million.

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1/ Midmonth employment estimates for 1961 were first published in January, 1962, and revised in January, 1963, by the California Department of Employment. The revised figures were used in this study.

2/ Harold E. Barnhill, Resource Requirements on Farms for Specified Operator Incomes, U. S. Department of Agriculture, Agricultural Economics Report No. 5, ERS-FED (February, 1962), 31p.

TABLE B.1

Agricultural Employment in San Benito County, by Type of Worker
Midmonth Estimates, 1961[a]

Month	Total	Farmers and unpaid families	Hired domestic	Foreign contract	Total paid workers
	1	2	3	4	5
January	1,340	550	790	0	790
February	1,650	550	1,100	0	1,100
March	1,710	550	1,160	0	1,160
April	2,170	550	1,620	0	1,620
May	1,990	550	1,340	100	1,440
June	1,790	550	1,140	100	1,240
July	5,660	540	5,120	0	5,120
August	1,910	540	1,370	0	1,370
September	5,440	540	3,070	1,830	4,900
October	3,240	540	1,170	1,530	2,700
November	1,620	530	840	250	1,090
December	1,250	530	720	0	720

a/ Revised, January, 1963.

Source: California Department of Employment, Research and Statistics Branch, Revision of California Agricultural Employment Estimates, Report No. 881M #1 and #2 (Sacramento, January, 1963).

TABLE B.2

Full-Time Equivalents of Midmonth Employment Estimates of Total Paid Workers
San Benito County, 1961

Month	Midmonth estimates[a]	Fraction of time worked	Reason	Full-time man-months	Man-hours per month	Wages per month per worker[b]
						dollars
January	790	One half	Slack season	395	26 x 8	260.00
February	1,100			550	26 x 8	260.00
March	1,160	Generally full time	Vegetables and seed crops	1,160	26 x 8	260.00
April	1,620			1,620	26 x 8	260.00
May	1,440			1,440	26 x 8	260.00
June	1,240			1,240	26 x 8	260.00
July[c]	5,120			5,120	20 x 9	225.00
August	1,370	Generally full time	Vegetables, seed crops, fruits, and nuts	1,370	26 x 9	292.50
September	4,900			4,900	26 x 9	292.50
October	2,700			2,700	26 x 9	292.50
November	1,090	One half	Slack season	545	26 x 8	260.00
December	720			360	26 x 8	260.00

a/ May, June, September, October, and November include contract foreign labor.

b/ At $1.25 per hour.

c/ Garlic harvest and the beginning of the prune and pear harvest.

Source: California Department of Employment, Research and Statistics Branch, Revision of California Agricultural Employment Estimates, Report No. 881M #1 and #2 (Sacramento, January, 1963).

TABLE B.3

Comparison of the Number of All Farms and of Commercial Farms and the Value of Agricultural Commodities Sold in California and San Benito County, 1959

	California	San Benito County
Total number of farms	99,274	811
Commercial farms	66,929	586
Value of farm products sold by commercial farms		
Total (million dollars)	2,829	29
Average per commercial farm (dollars)	42,267	26,623

Source: U. S. Bureau of the Census, U. S. Census of Agriculture, 1959, Vol. I, Part 48, 1963.

The total household input, including profits, was calculated as the sum of total hired wages ($5.469 million) and total operators' income ($3.300 million), or $8.769 million.

Food processing, manufacturing, and wholesale and retail: Similar adjustments were made in the household input into the food processing, manufacturing, and wholesale and retail sectors. These are given in the following tabulation:

Sector	1958		1961	
	Number of persons employed	Payroll	Number of persons employed	Household input
	1	2	3	4
		thousand dollars		thousand dollars
Food processing	557	2,630	489	2,700
Manufacturing	250	1,403	405	2,658
Wholesale and retail	567	1,651	650	2,213

Sources:

Cols. 1 and 2: 1958 U. S. Censuses of Manufacturers and Business.
Col. 3: Obtained from survey.
Col. 4: Adjusted for changes in employment and an increase of 16.94 percent in total personal income between 1958 and 1961.

Nonmanufacturing, including business services: The following figures on state employment and total personal income for 1961, by type of industry, were obtained from the California Statistical Abstract, 1962.

Type of nonmanufacturing industry	Number of persons employed	Total personal income	Average income per person employed
	thousand	million dollars	dollars
Mining	30.0	212	7,067
Construction	291.7	2,028	6,952
Finance, real estate, and insurance	249.7	1,460	5,847
Services	750.4	3,864	5,149

Employment for 1961 in the nonmanufacturing subsectors of San Benito County was as follows:

Subsector	Number of persons employed
Mining	300
Construction	100
Finance, real estate, and insurance	65
Services	500
Other nonmanufacturing	625
Total employment	1,590

Sector 7--Exports

Exports are defined as direct sales made by local sectors outside the County. Entries for the several sectors were based on data obtained in the survey, with minor adjustment in the food processing and manufacturing sectors. Exports of the household (labor) sector represent a residual calculated to balance the row and column totals. These amounted to approximately $8.577 million and consisted mainly of (1) persons employed in all levels of government and (2) persons employed outside the County.

APPENDIX C

Projections of Personal Income

As defined in this study, personal income includes current income of individuals, unincorporated businesses, and nonprofit organizations from all sources. This definition is comparable to that adopted by the U. S. Department of Commerce in its estimates of personal income published in the Survey of Current Business. Total personal income, per capita income, and population for both San Benito County and California are presented in Table C.1. The income figures are expressed in constant dollars, with 1947-1949 as the base.

The following formula was used to estimate the various rates of growth in real income (1947-1949 base):

$$A_t = A_o \left(1 + \frac{r}{100}\right)^t$$

where

A_t = real income in year t;

A_o = income in base period, 1947-1949; and

r = average rate of growth during the period.

Rates of growth in per capita real income and population were similarly estimated.

The average rates of growth in per capita income, total personal income, and population during 1947-1961 for San Benito County and California are summarized in Table C.2.

The following conclusions can be drawn from these calculations:

1. The rate of population growth in San Benito County, 0.5 percent, is considerably slower than the rate of growth in California as a whole, 4.0 percent.

2. Per capita income is increasing faster in the County than in the state, 2.2 percent as compared with 1.5 percent.

TABLE C.1

Population and Per Capita and Total Personal Income[a/]
San Benito County and California, 1947-1961

Year	San Benito County			California		
	Population	Per capita personal income	Total personal income	Population	Per capita personal income	Total personal income
		dollars	thousand dollars	thousand	dollars	million dollars
1947-48	14,990	1,511	22,655	9,832	1,777	17,421
1948-49	14,370	1,506	21,638	10,064	1,709	17,197
1949-50	13,980	1,451	20,272	10,337	1,690	17,468
1950-51	14,300	1,540	22,022	10,668	1,793	19,130
1951-52	13,800	1,547	21,347	11,108	1,846	20,455
1952-53	13,900	1,555	21,607	11,633	1,872	21,912
1953-54	14,900	1,634	22,890	12,093	1,901	22,987
1954-55	14,500	1,568	22,736	12,511	1,885	23,648
1955-56	14,700	1,753	25,781	13,003	2,010	26,145
1956-57	14,900	1,858	27,691	13,578	2,081	28,245
1957-58	15,100	1,790	27,030	14,168	2,058	29,166
1958-59	15,300	1,764	26,985	14,735	2,001	29,486
1959-60	15,200	1,932	29,365	15,277	2,088	31,900
1960-61	15,500	1,964	30,446	15,860	2,077	32,943

a/ Constant dollars (1947-1949).

TABLE C.2

Average Rates of Growth in Real Income and Population[a/]
San Benito County and California, 1947-1961

	San Benito County	California
	percent	
Total personal income	2.7	5.5
Per capita personal income	2.2	1.5
Population	0.5	4.0

a/ See text for derivation of growth rates.

3. Total personal income in the state is growing at the rate of 5.5 percent, mainly because of increasing population.[1/] On the other hand, total personal income in the County is growing at the rate of 2.7 percent, largely as a result of actual increases in per capita income. This is to be expected in typical nonmetropolitan areas which have begun to shift from a predominantly rural to an urban economic structure but have not yet greatly increased their industrial and commercial activities.

On the basis of the calculated average rates of growth, projections of personal income and per capita income were computed for five-year intervals from 1960-61 through 1980-81. These projections for the County and the State are summarized in Table C.3. The projected increases in total personal income may result either from increases in population or from increases in per capita real income, or they may materialize out of a combination of increases in both population and per capita real income. In each case the impact of changes in final demand upon the local economic structure would be different.

The projections in Table C.3 indicate further that per capita real income in San Benito County, growing at an average rate of about 2.2 percent,

- -

1/ Other studies on growth in California economy give a lower rate of growth. In 1960 the Stanford Research Institute published a study based on previous studies of income trends and production trends in which the indicated growth rate was in the order of 3 percent. Essentially, it was a long-run study going as far back as 1929, omitting the war years (1943-1945) but not the depression years of the 1930's.

The projection procedure adopted in these earlier studies is that of linear regression relationships between different concepts of income, such as gross national product and spendable income, and estimates are derived for broad census regions in the nation and for the eleven western states. Differences in projections have resulted mainly from differences in scope and method of approach. Readers interested in these studies may see:

Bonnar Brown and Janet Hansen Tate, Income Trends in the United States Through 1975 (Menlo Park, California: Stanford Research Institute, December, 1957), 125p.

Idem, Production Trends in the United States Through 1975 (Menlo Park, California: Stanford Research Institute, March, 1957).

Robert K. Arnold et al., California Economy, 1947-1980 (Menlo Park, California: Stanford Research Institute, December, 1960).

TABLE C.3

Projections of Real Per Capita and Total Personal Income[a/]
San Benito County and California
1960-61 through 1980-81

Year	San Benito County		California	
	Per capita personal income	Total personal income	Per capita personal income	Total personal income
	1	2	3	4
	dollars	thousand dollars	dollars	million dollars
1960-61 (actual)	1,964	30,452	2,077	32,943
1965-66	2,192	34,746	2,236	43,082
1970-71	2,447	39,679	2,406	56,323
1975-76	2,730	45,313	2,589	73,650
1980-81	3,048	51,708	2,786	96,255

a/ Constant dollars (1947-1949).

appears likely to catch up with California per capita real income by 1970 and may even exceed the California figures by as much as 5.4 percent in 1975-76.

A tendency toward equalization has been evident between county and state per capita income during the years 1947-1961, as shown by the following ratios of per capita income (San Benito County per capita income divided by California per capita income): 1947-48, 0.85; 1960-61, 0.95; 1965-66, 0.98; 1970-71, 1.02; and 1975-76, 1.05. On the basis of these ratios, it would seem that the tendency toward equalization may continue. Nevertheless, it is possible that the County per capita income may not in fact surpass the California figure if the high population growth rate built into the projection of California's population fails to materialize. On the other hand, a spurt of population growth in the County could reduce its projected per capita income level.

A final point of interest: it appears that by 1975-76 total personal income for the County may be double that of 1947-1949. This rapid growth may even be accelerated should an unexpected population spurt occur before 1975.

APPENDIX D

To facilitate analysis in terms of changes in employment rather than output, Table D.1 gives the ratios for converting output requirements into employment requirements, assuming no changes in the efficiency of labor.

Table D.2 gives the employment requirements in each of the industries, corresponding to a change of $1 million in the final demand for their products and services.

TABLE D.1

Table of Conversion Ratios: Output to Employment Equivalents[a/]
Models I and II

Producing sectors	Full time employment equivalents	Output	Employment per $1 million of output[b/]
	1	2	3
	man-years	thousand dollars	man-years
1. Agriculture	2,333	21,193	110.0835
2. Food processing	489	13,312	36.7338
3. Manufacturing	405	6,641	60.9847
4. Nonmanufacturing, including business services	1,590	19,909	79.8633
5. Wholesale and retail	650	23,070	28.1751
6. Household (labor)[b/]	500	39,854	12.5458

a/ The ratios in column 3 are used to convert the dollar value of output to its employment equivalents.

b/ Ratios for Sectors 1-5 are common to Models I and II. The ratio for Sector 6 is applicable only in Model II, since this sector is exogenous in Model I.

APPENDIX E

Appendix Tables and Explanatory Notes for the Analysis of Alternative Changes in Demand

Explanatory Notes

The following notes are applicable to each set of assumptions as discussed in the text. The procedure of calculation is identical in each case.

Tables E.1 to E.6 relate to Model I; Tables E.7 and E.8 relate to Model II.

Columns 1 and 2.--Local demand and export demand for products and services of each of the five endogenous sectors are based on the 1961 values and alternate growth rates specified for each assumption set. The following formula was used for projection to 1975:

$$A_t = A_o(1 + r_i)^t$$

where

A_t = the projected value in 1975;

A_o = the 1961 value;

t = the number of years; and

r_i = the specified average growth rate expressed in percent per year in industry i.

The projected demand for the year 1975 is expressed in 1961 dollars.

Column 3.--Total final demand is the sum of columns 1 and 2.

Column 4.--The output composition in column 4 is obtained by using the total final demand (column 3) and the interdependence coefficients, Model I.

Column 5.--This column gives the percentage increase over 1961 in the output of each endogenous sector.

Columns 6 and 7.--Output forecasts given in column 4 are converted to employment forecasts in columns 6 and 7. Column 6 gives the employment forecasts on the basis of the 1961 relationship between output and employment, whereas column 7 gives the adjusted employment forecasts corresponding to increases in productivity of labor. Column 6 is based on the following formula:

TABLE E.1

Model I

Analysis of Impact of Economic Growth on San Benito County Economy, 1975
Assumption Set I: Local Demand, 3 Percent; Agriculture and Food Processing Export Demand, 5.5 Percent and Other Export Demand, 5.5 Percent

Producing industry	Local demand	Export demand	Total final demand	Output requirements		Employment		Personal income	
				In 1961 constant dollars	Increase over 1961	Using 1961 relations	Adjusted for increases in productivity	In 1961 constant dollars	Increase over 1961
	thousand dollars			thousand dollars	percent	man-years		thousand dollars	percent
	1	2	3	4	5	6	7	8	9
1. Agriculture	a/	32,134	32,134	47,231	122.9	5,119	3,008	19,543	122.9
2. Food processing	a/	26,909	26,909	29,742	123.4	1,093	714	6,032	123.4
3. Manufacturing	342	13,499	13,841	14,639	120.4	893	739	5,859	120.4
4. Nonmanufacturing, including business services	7,986	9,330	17,316	38,505	93.4	3,075	2,431	18,387	93.4
5. Wholesale and retail	26,537	3,553	30,090	38,034	64.9	1,072	1,029	3,648	64.9
Total endogenous sectors	34,865	85,425	120,290	168,151	100.0	11,332	7,921	53,469	106.9

a/ Negligible.

TABLE E.2

Model I

Analysis of Impact of Economic Growth on San Benito County Economy, 1975
Assumption Set II: Local Demand, 3 Percent; Agriculture and Food Processing Export Demand, 3 Percent and Other Export Demand, 5.5 Percent

Producing industry	Local demand	Export demand	Total final demand	Output requirements		Employment		Personal income	
				In 1961 constant dollars	Increase over 1961	Using 1961 relations	Adjusted for increases in productivity	In 1961 constant dollars	Increase over 1961
	thousand dollars			thousand dollars	percent	man-years		thousand dollars	percent
	1	2	3	4	5	6	7	8	9
1. Agriculture	a/	22,362	22,362	32,972	55.6	3,630	2,133	13,643	55.6
2. Food processing	a/	18,726	18,726	20,712	55.6	761	497	4,201	55.6
3. Manufacturing	342	13,499	13,841	14,471	117.9	883	730	5,792	117.9
4. Nonmanufacturing, including business services	7,986	9,330	17,316	36,020	80.9	2,877	2,274	17,200	80.9
5. Wholesale and retail	26,537	3,553	30,090	35,831	55.3	1,010	969	3,437	55.3
Total endogehous sectors	34,865	67,470	102,335	140,006	66.4	9,161	6,603	44,273	71.3

a/ Negligible.

TABLE E.3

Model I

Analysis of Impact of Economic Growth on San Benito County Economy, 1975
Assumption Set III: Local Demand, 3 Percent; Agriculture and Food Processing Export Demand, 3 Percent and Other Export Demand, 3 Percent

Producing industry	Local demand	Export demand	Total final demand	Output requirements		Employment		Personal income	
				In 1961 constant dollars	Increase over 1961	Using 1961 relations	Adjusted for increases in productivity	In 1961 constant dollars	Increase over 1961
	thousand dollars			thousand dollars	percent	man-years		thousand dollars	percent
	1	2	3	4	5	6	7	8	9
1. Agriculture	a/	22,362	22,362	32,959	55.5	3,628	2,132	13,637	55.5
2. Food processing	a/	18,726	13,726	20,709	55.6	761	497	4,200	55.6
3. Manufacturing	342	9,394	9,736	10,313	55.3	629	520	4,128	55.3
4. Nonmanufacturing, including business services	7,986	6,492	14,478	30,429	52.8	2,430	1,921	14,531	52.8
5. Wholesale and retail	26,537	2,472	29,009	34,664	50.3	977	938	3,325	50.2
Total endogenous sectors	34,865	59,446	94,311	129,074	53.4	8,425	6,008	39,821	54.1

a/ Negligible.

TABLE E.4

Model I

Analysis of Impact of Economic Growth on San Benito County Economy, 1975
Assumption Set IV: Local Demand, 5.5 Percent; Agriculture and Food Processing Export Demand, 5.5 Percent and Other Export Demand, 5.5 Percent

Producing industry	Local demand	Export demand	Total final demand	Output requirements		Employment		Personal income	
				In 1961 constant dollars	Increase over 1961	Using 1961 relations	Adjusted for increases in productivity	In 1961 constant dollars	Increase over 1961
	thousand dollars			thousand dollars	percent	man-years		thousand dollars	percent
	1	2	3	4	5	6	7	8	9
1. Agriculture	a/	32,134	32,134	47,381	123.6	5,216	3,065	19,605	123.6
2. Food processing	a/	26,909	26,909	29,762	123.6	1,093	714	6,036	123.6
3. Manufacturing	514	13,499	14,013	14,847	123.6	905	749	5,942	123.6
4. Nonmanufacturing, including business services	11,999	9,330	21,329	44,511	123.6	3,555	2,810	21,255	123.6
5. Wholesale and retail	39,871	3,553	43,424	51,578	123.6	1,453	1,394	4,948	123.6
Total endogenous sectors	52,384	85,425	137,809	188,079	123.6	12,222	8,732	57,786	123.6

a/ Negligible.

TABLE E.5

Model I

Analysis of Impact of Economic Growth on San Benito County Economy, 1975
Assumption Set V: Local Demand, 5.5 Percent; Agriculture and Food Processing Export Demand, 3 Percent and Other Export Demand, 5.5 Percent

Producing industry	Local demand	Export demand	Total final demand	Output Requirements		Employment		Personal income	
				In 1961 constant dollars	Increase over 1961	Using 1961 relations	Adjusted for increases in productivity	In 1961 constant dollars	Increase over 1961
	thousand dollars			thousand dollars	percent	man-years		thousand dollars	percent
	1	2	3	4	5	6	7	8	9
1. Agriculture	a/	22,362	22,362	33,122	56.3	3,646	2,142	13,705	56.3
2. Food processing	a/	18,726	18,726	20,731	55.7	762	498	4,205	55.7
3. Manufacturing	514	13,499	14,013	14,679	121.0	895	740	5,875	121.0
4. Nonmanufacturing, including business services	11,999	9,330	21,329	42,026	111.1	3,356	2,653	20,068	111.1
5. Wholesale and retail	39,871	3,553	43,424	49,374	114.0	1,391	1,335	4,736	114.0
Total endogenous sectors	52,384	67,470	119,854	159,932	90.1	10,050	7,368	48,589	88.0

a/ Negligible.

TABLE E.6

Model I

Analysis of Impact of Economic Growth on San Benito County Economy, 1975
Assumption Set VI: Local Demand, 5.5 Percent; Agriculture and Food Processing Export Demand, 3 Percent and Other Export Demand, 3 Percent

Producing industry	Local demand	Export demand	Total final demand	Output requirements		Employment		Personal income	
				In 1961 constant dollars	Increase over 1961	Using 1961 relations	Adjusted for increases in productivity	In 1961 constant dollars	Increase over 1961
	thousand dollars			thousand dollars	percent	man-years		thousand dollars	percent
	1	2	3	4	5	6	7	8	9
1. Agriculture	a/	22,362	22,362	33,109	56.2	3,645	2,142	13,699	56.2
2. Food processing	a/	18,726	18,726	20,729	55.7	761	497	4,204	55.7
3. Manufacturing	514	9,394	9,908	10,521	58.4	642	531	4,211	58.4
4. Nonmanufacturing, including business services	11,999	6,492	18,491	36,435	83.0	2,910	2,300	17,399	83.0
5. Wholesale and retail	39,871	2,472	42,343	48,208	109.0	1,358	1,303	4,624	108.9
Total endogenous sectors	52,384	59,446	111,830	149,002	77.1	9,316	6,773	44,137	70.8

a/ Negligible.

TABLE E.7

Model II

Analysis of Impact of Economic Growth on San Benito County Economy, 1975
Assumption Set II-a: Agriculture and Food Processing Export Demand, 3 Percent
Household (Labor) Export Demand, 3 Percent; and Other Export Demand, 5.5 Percent

Producing sectors	Final export demand	Output requirements		Employment	
		1975	Increase over 1961	Using 1961 relations	Adjusted for increases in productivity
	thousand dollars	thousand dollars	percent	man-years	
1. Agriculture	22,362	33,017	55.8	3,635	2,136
2. Food processing	18,726	20,718	55.6	761	497
3. Manufacturing	13,499	14,533	118.8	886	732
4. Nonmanufacturing, including business services	9,330	37,813	89.9	2,070	1,636
5. Wholesale and retail	3,553	39,873	72.8	1,123	1,077
6. Household (labor)	13,344	68,197	71.7	856	677
Total endogenous sectors	80,814	214,151	72.7	9,331	6,755

TABLE E.8

Model II

Analysis of Impact of Economic Growth on San Benito County Economy, 1975
Assumption Set V-a: Agriculture and Food Processing Export Demand, 3 Percent
Household (Labor) Export Demand, 5.5 Percent; and Other Export Demand, 5.5 Percent

Producing sectors	Final export demand	Output requirements		Employment	
		1975	Increase over 1961	Using 1961 relations	Adjusted for increases in productivity
	thousand dollars	thousand dollars	percent	man-years	
1. Agriculture	22,362	33,058	56.0	3,639	2,138
2. Food processing	18,726	20,723	55.7	761	497
3. Manufacturing	13,499	14,590	119.7	890	736
4. Nonmanufacturing, including business services	9,330	39,448	98.1	2,160	1,707
5. Wholesale and retail	3,553	43,560	88.8	1,227	1,177
6. Household (labor)	19,175	76,308	91.5	957	756
Total endogenous sectors	86,645	227,687	83.6	9,634	7,011

$$\frac{X_{it}}{X_{io}} \cdot N_{io}$$

where

X_{it} = the output forecast for industry i;

X_{io} = the 1961 output of industry i;

N_{io} = the employment (man-year equivalent) in industry i in 1961; and

t = the forecast period, 1975.

Column 7 is based on the following formula:

$$\frac{X_{it}}{X_{io}} \frac{N_{io}}{(1 + r_i)^t}$$

where

$\frac{1}{(1 + r_i)^t}$ represents the correction for productivity increases.

Columns 8 and 9.--Personal income was obtained for each endogenous sector by utilizing the corresponding household technical coefficient (household input) and the output projections. The percentage increases shown in column 9 for each sector agree with those in column 5.

Derivation of Productivity Growth Rates

The following productivity growth rates (r_i) are used in the development of the adjusted employment forecast for each endogenous sector (i):

Endogenous sector (i)	Productivity growth rate (r_i)
	percent
Agriculture	3.9
Food processing	2.9
Manufacturing	1.3
Nonmanufacturing, including business services	1.6
Wholesale and retail	0.3

The chief source for data was the index of farm output per man-hour worked, by regions, 1957-1959 base, published by the U. S. Department of agriculture.[1/]

A review of this index indicates that during the period 1939-1960, as well as the subperiod 1947-1961, productivity in agriculture per man-hour has been increasing in the Pacific region at approximately 4 percent per year. This rate of growth in productivity was used in adjusting the employment forecasts in agriculture.

No other published productivity growth rates are available in enough detail to suit the classification of endogenous sectors as defined for this study. However, detailed data on national income and full-time employment equivalents are published by the U. S. Department of Commerce.[2/] Productivity growth rates were calculated using the deflated value of national income and full-time employment for the period 1956-1961. The formula used was the same as that for agriculture.

1/ U. S. Economic Research Service, Changes in Farm Production and Efficiency, Statistical Bulletin No. 233, September, 1962, p. 46.

2/ U. S. Department of Commerce, Office of Business Economics, Survey of Current Business, Vol. XLII, No. 7, 1962.

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